DOCUMENT RESUME

ED 067 003 HE 003 276

AUTHOR	Olson, Carl J.; And Others
TITLE	The Orthopaedic Training Study, Phase II 1968-1972. Final Report, Volume I.
INSTITUTION	Illinois Univ., Urbana. Medical Center.
SPONS AGENCY	Public Health Service (DHEW), Washington, D.C. Bureau of Health Professions Education and Manpower Training.
PUB DATE	[72]
NOTE	120p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Higher Education; *Laboratories; *Medical Education; *Medical Students; Skill Development; *Training Laboratories

ABSTRACT

Phase two of the Orthopaedic Training Study was designed to examine time, sequence, and content requirements of existing orthopaedic programs. Specifically, the proposal was designed to achieve the following objectives: (1) to provide a model of individualized graduate education in medicine in which the demonstration of individual competence marks the end of formal training; (2) to document the nature and variation of orthopaedic training in the U.S.; (3) to devise and test methods for increasing the efficiency and effectiveness of orthopaedic training; (4) to determine the relationships between input training and output variables; (5) to develop mechanisms that will facilitate continuing institutional self-study of training programs; and (6) to develop a pool of educational specialists in orthopaedics who can provide continuing leadership in the field. This document presents a report of the results of the study with remarks about implications for further study and development of programs. See also HE 003 277 and HE 003 275. (HS)

ED 067003

THE ORTHOPAEDIC TRAINING STUDY

Phase II 1968 - 1972

FINAL REPORT

VOLUME I

PM-00014

ORTHOPAEDIC TRAINING STUDY STAFF

Professional Staff

Thomas J. Bligh M.Ed.
James L. Coole, M.S.
Penny Edgert, M.A.
Brian Huncke, M.D.
James Monahan, M.A.

Fellowship Staff

Gary Barham, M.D.
Richard Dimond, M.D.
Henry Hood, M.D.
Joseph Kopta, M.D.
Henry LaRocca, M.D.
Edward Mc Carthy. M.D.
Clyde L. Nash, M.D.
H. Bates Noble, M.D.

TABLE OF CONTENTS

VOLUME I		PAGE
I.	INTRODUCTION AND SPECIFIC AIMS	
	A. BACKGROUND	1
	B. METHODS	4
II.	NATURE AND VARIATION OF	
	A. PROGRAMS	19
	B. RESIDENTS AND ATTENDINGS	41
III.	ANALYTIC STUDIES	67
IV.	PREDICTION STUDY	98
VOLUME II		
	SUPPLEMENT	

LIST OF TABLES

SEC. NO.	TABLE NO.	TITLE	PAGE
II -	1	Programs Reporting Subspecialists (Percentages)	23
	2	Resident Patient Care Responsibility by Year in Training (Percentages)	37
	3	Program Characteristics by Type of Program	38-39-40
	4	Satisfaction with Attendings as Teachers	44
	5	Resident Teaching Responsibilities	45
	6	Dissatisfaction with Hospital Procedures	46
	7	Resident Attitudes (In agreement)	47-48
	8	Resident Attitudes (Disagreement)	49
	9	Mean Hours per Week Residents Spent in Selected Activities	52
	10	Weekly Hours per Category	53
	11	Attending's role at the operation	61
	12	Attending Attitude Survey (Agreement)	64-65
	13	Attending Attitude Survey (Disagreed)	66
III	1	Population-Study Sample Comparison	72
	2	Correlations of Chiefs' Ratings of Residents at the First, Second and Third Years of Training	75

LIST OF TABLES
(Continued)

SEC. NO.	TABLE NO.	TITLE	PAGE
III	3	Mean Chiefs' Ratings for each Year in Training	76
	4	Selected Correlations between Chiefs' Ratings and OITE Scores for each Year in Training	81
	5	Significant Correlations between Resident Attitude Statements and OITE Score	86
	6	Average Percentile Rank of ARBCs Compared to Residents at the same Year of Training on the Multiple Choice Section of the OITE	90
	7	Average Chief's Evaluation of ARBCs and All other Residents in the same Year in Training	92
	8	Correlations between OITE and OCE Scores	97
IV	1	Items Included in the Prediction Study	100
	2	Interaction of Resident and Program Characteristics in Predicting Multiple Choice Scores	102
	3	Program Characteristics Related to Multiple Choice Score Prediction	103
	4	Characteristics of Residents and Programs Related to OITE Multiple Choice Scores (University Programs)	104

LIST OF TABLES
(Continued)

SEC. NO.	TABLE NO.	TITLE	PAGE
IV	5	Characteristics of Residents and Programs Related to OITE Multiple Choice Scores (Independent Programs)	105
	6	Interaction of Resident and Program Characteristics in Predicting PMP Scores	107
	7	Characteristics of Residents and Programs Related to OITE PMP Scores (University Programs)	108
	8	Characteristics of Residents and Programs Related to OITE PMP Scores (Independent Programs)	109

INTRODUCTION

Phase II of the Orthopaedic Training Study represents a landmark in the fullest sense of the word. It is the hope of the Study Staff that the information and experience gained in this, the first intensive study of medical specialty training, will serve as a model for others. However, the landmark indicates the beginning rather than the end of the trail. Even the beginning could not have been achieved without the cooperation of many representatives of the orthopaedic community and the efforts of the research staff. Most notable among the former were the members of the Advisory Committee, Drs. George T. Aitken, Paul Curtiss, Charles Herndon, Walter Hoyt, Jr., Paul Lipscomb and Fred C. Reynolds. It is to these men the Staff looked for guidance, they were never found wanting.

The Final Report is divided into two volumes, the first briefly contains the following information:

I. Introduction and specific aims

   A. Background

   B. Methodology

II. Nature and Variation of --

   A. Programs

   B. Residents and attendings

III. Analytic Study

IV. Prediction Study

The second volume, or Supplement, contains copies of most of the Study instruments, working papers, and report documents which will be helpful to those wishing to utilize the methodology developed.

The report contains only a small portion of the materials developed for the Study and the data generated through data collection efforts. Complete information is available from the Center for Educational Development provided the request is approved by the Advisory Committee.

I - INTRODUCTION AND SPECIFIC AIMS

FOREWORD

There has been a steady trend toward increased specialization in medicine during the last 20 years. Parallel with, and indeed a part of this development has been increased emphasis on formal board certification, both in the traditional specialities and the growing number of sub-specialities. Evidence of this can be seen in two areas: First, a general agreement that both services at the community level have improved, both in quality and variety. Second, a growing concern that the potential practitioner is being required to invest greater periods of time in training, thus reducing his availability to deliver these health services. Concurrent with this concern is a question about the rigidity of time requirements which appear to deny an opportunity for individual differences and the structuring of time requirements on some basis other than empiric.

A general review of Board speciality requirements suggests that, while attempts are being made to apply our general knowledge to differences in learning speed and patterns to training programs, a systematic effort to apply this knowledge had not been attempted. Finally, an empiric justification for the restructuring of both training programs and board requirements to allow for these differences could not be found in the research literature extant.

It was discussions of this sort that led to an agreement between the American Board of Orthopaedic Surgery (ABOS) and the Center for Educational Development which culminated in a research project, "Efficient Use of Medical Manpower," funded by the Bureau of State Services. This Study was to focus on the definition and measurement of professional competence in orthopaedics, with the aim of increasing the validity and the reliability of such appraisals so that the Board could accept measures of competence as the primary criterion for certification. After reviewing the research completed and the resultant evaluation procedures developed from that research, the Board, in a meeting on June 30, 1967, agreed that it was time to begin experimental modification of sequence, time, and content requirements on a controlled Study sample.

At this same time the Skeletal Systems Committee of the National Research Council - National Academy of Science became concerned over the failure of orthopaedic training to produce academically oriented orthopaedists. It was apparent that these programs produced highly skilled orthopaedists, many of whom became outstanding program directors but who had little familiarity with the vast body of knowledge in education and with application to instructional practices in orthopaedics.

On April 21, 1967, the NRC-NAS Skeletal Systems Committee agreed to lend support to the orthopaedic community for the development and implementation of a study designed to examine time, sequence and content requirements of existing orthopaedic programs. Specifically, the proposal, an extention of Phase I*, was designed to achieve the following broad objectives:

1. To provide a model of individualized graduate education in medicine in which the demonstration of individual competence, rather than the fulfillment of rigid time and content requirements, mark the end point of formal training.

2. To document the nature and variation of orthopaedic training in the United States.

3. To devise and test methods for increasing the efficiency and effectiveness of orthopaedic training.

4. To determine the relationships between input training and output variables.

5. To develop mechanisms that will facilitate continuing institutional self-study of training programs.

---

*This report of Phase I is available from the Center for Educational Development.

6. To develop a pool of educational specialists in orthopaedics who can provide continuing leadership in the field.

Study Organization

In order to achieve these objectives, a rather unique consortium was established with three principal elements: a professional education staff, an advisory committee and a cadre of trained orthopaedic educators. Each of these groups provided a unique contribution to the Study. First, the professional education staff was able to supply an extensive knowledge of the science of education and research methodology to clarify questions and propose mechanisms for obtaining their answers. In addition, they provided the operating personnel for the Study, implementing plans, and providing coordination among the other groups involved in the Study. This staff varied from one to four education professionals, the number dependant upon the particular portion of the Study being undertaken at the time. Second, an Advisory Committee* performed several unique services in addition to serving as representatives of the orthopaedic community and voicing their concerns. They provided broad range policies under which the Study operated, served as monitors of progress and direction, and finally, provided liaison with members of the orthopaedic community. The third group consisted of consultants. Under provisions of the Grant selected residents could substitute a portion of their residency requirement by serving as consultants to the Orthopaedic Training Study. This arrangement permitted them to gain expertise in the field of education while providing valuable subject matter input to the educational staff of the Study. Two men availed themselves of one-year fellowships and earned Masters' degrees in Medical Education. Two spent six months at the Center for Educational Development, while one spent approximately four months at the Center, and two others 30 days each.

---

*The Advisory Committee consisted of two representatives from the Board, the Academy, and the MSC-NCR who were respectively Drs. Walter A. Hoyt, Jr. and Paul R. Lipscomb; Drs. George T. Aitken and Charles H. Herndon; and Drs. Fred Reynolds and Paul H. Curtiss, Jr.

Methods of Procedure

The accomplishment of these goals within the proposed four-year study period required that several phases of the Study be conducted simultaneously, but for clarity of presentation, the elements of the Study will be described independently.

1. Introduction of Flexibility. Early data from the Orthopaedic In-Training Examination (OITE) had shown the wide range of achievement among residents in each year of training programs and the substantial overlap of achievement among individuals in all four years. The evidence suggested that some residents might qualify for certification in a significantly shorter time than was presently required even without modification of instructional content or methodology. In order to provide an early opportunity to demonstrate the validity of this hypothesis, 16 training programs, consisting of 280 residents* were designated as an intensive study group. The criteria for selection was developed jointly by an Advisory Committee representing the three participating agencies.

The cooperation of these program directors was enlisted to permit their residents, with the authorization of the Americal Board of Orthopaedic Surgery, to depart from the present time and content distribution requirements without jeopardizing their eligibility for Board certification.* The participating residents were authorized to present an application for examination to the Board Committee on eligibility when, in the opinion of their program director, they were prepared to take the Board examination. Candidates who successfully completed the Board examination could proceed immediately to fulfill the practice requirement (presently one year) and, at the conclusion of that period, apply for final certification.

---

* See Supplement.

In order to maximize the opportunity for increasing the speed and efficiency of learning, program directors in the intensive study group were provided with assistance in introducing a process of continuous performance monitoring and giving feedback to the resident in order that both staff and resident might be aware of the individual progress toward achievement of the critical components of competence in orthopaedics.

The instruments to be used in this assessment included the annual In-Training Examinationgiven by the American Academy of Orthopaedic Surgery (developed by the Center, with the assistance of professional staff members from the Board), and a variety of check lists, rating scales, and tests of complex cognitive and interpretive skills developed in the original study.

A second consideration in flexibility was the proposal for program modification that would have the effect of introducint greater variety within a program in order to respond to differences in resident needs and interests.

Residents in some programs were encouraged to substitute a 6 to 12 month fellowship in research in medical education for more conventional rotations. Residents who took their Board exam earlier than usual opted from among several alternatives.*

2. Intensive Study of Training Experiences. The critical components of competence in orthopaedic surgery defined the educational goals toward which training programs should be directed.** The purpose of this phase of the Study identified the extent to which 1) training programs provide opportunities for residents to gain the defined knowledge, skills and attitudes, 2) the curricular organization, instructional materials and methods conform to generally accepted principles of learning and 3) system-

---

*For a study of these early board candidates, see part 2, section 2.

**Critical Components of Competency are discussed in the Final Report of Phase I.

atic evaluation is conducted and utilized for continuous program assessment.

A stratified study sample (the intensive study group and the survey group*) of the 187 approved residency programs was selected to represent variations in academic affiliation, hopsital size, nature of population served, and geographic location. Each program was analyzed to document the following.

A. Program organization - including schedule of resident rotation, the personnel who supervise training, the facilities and resources to support the training.

B. Program objectives - the mechanism created for establishment, review, and communication of the objectives to staff and residents.

C. Program operation - activities and responsibilities of a resident sample, the nature or instructional procedures, of both a formal and informal nature, the nature of feedback to residents of their individual strengths and weaknesses as training progresses.

D. Program evaluation - the mechanisms employed to accumulate data about resident progress, program effectiveness and the utilization of these data in continuing program review.

E. Program perceptions - identification of similarities among residents and staff in the perception of purposes, procedures and effectiveness.

The variables (See Table IV - 1, p. 100) identified for objective 2 required diverse data, some of which already existed. Data included information on a resident's sex, marital status, academic background, internship, knowledge of science, ability at patient interviewing, etc.

---

*The survey sample consisted of 35 resident training programs which received only the survey instruments. See supplement for a list of their programs.

Generally, the material which had to be gathered included information concerning background characteristics and training experiences with specific orthopaedic procedures. Type, location, and size of the program setting were areas of available institutional information while checklists, interviews, and questionnaires generated details of the program's mission or role in the community, association with other programs, room arrangement, support services (brace shops, physical therapy, special laboratories), etc. In addition to the general and specific characteristics of the program setting, other training variables for which information had to be gathered were the nature of resident responsibility for patient care, patterns of rotation, and professional qualifications of attendings. Knowledge, interpretive skills, and problem solving skills of the residents constituted the output variables and were measured by the Academy's In-Training Examination.

The instruments* constructed to gather the above information were the following:

The Program Description Questionnaire was designed to elicit information for classifying currently approved programs according to affiliation, sources of financial support, administrative organization, primary commitment, orientation, physical facilities, clinical material, staff resources, size, program objectives and organization, education activities, resident responsibilities and the like. This document was completed by 80 percent of the directors of all approved residency programs in orthopaedics in the United States.**

The Institutional Description Form was designed to elicit detailed information from all institutions affiliated with each program regarding the type of institution, primary mission, sources of financial support, administrative structure, educational resources, characteristics of the patient population served, interrelations among subspecialty services, patient care facilities and supporting

---

*See Supplement for samples.

**There was a 70 percent return on a re-distribution of this questionnaire in 1971.

services and decision-making process in screening patients for admission and directing their total health care. The form was completed by 78 percent of the directors of each institution affiliated with each program of the Study samples.

The Resident Evaluation Form and The Candidate Evaluation Form were designed to obtain preceptors ratings of residents and of candidates for certification, with respect to each of a number of performance factors related to the several components of competence identified as critical performance requirements. The Candidate Evaluation Form was completed by at least two persons who had known each resident over an extended period of time. The Resident Evaluation Form was completed by the chief.

The Resident Evaluation of Operative Procedures was designed to identify the nature of the resident's experience and the character of his responsibility with regard to various decision points in the operative management of patients and was returned by 90 percent of the residents in the Study.

The Resident Procedures Form was designed to determine the resident's experience with technical procedures and his degree of confidence in ability to perform them. The form enabled identification of the setting in which he learned to perform a procedure and the nature of the supervision under which he learned it. The form listed 58 sample treatment and orthopaedic procedures and was completed by 78 percent of residents in the Study sample.

The Resident Time Log was designed to discover variations in the work pattern in different orthopaedic residency programs. It was completed by 66 percent of residents in the Study samples at specified calendar periods selected to sample resident activities in each program.

The Resident Attitude Survey was designed to identify both within and between program variations in the attitudes of residents toward patients, colleagues, instructional staff, physical and clinical facilities, and the profession and the training program. It was completed by 88 percent of

residents in the Study groups.

The Resident Background Survey was designed to identify differences among residents in terms of their personal background, education experience and attitudes. It was completed by 98 percent of residents in the Study sample.

The Attending Attitude Survey was designed to elicit attending staff attitudes toward program organization, teaching styles, resident behavior, interaction with residents and with staff, etc. The survey was completed by 35 percent of attendings in the Study.

In addition to specifically designed instruments, data collection for this study employed other survey and observational techniques. In the first round of site visits, survey data was verified in an interview* with program chiefs and residents in training by requesting descriptive information on the educational resources actually used in training, the nature and amount of instructional activity in which residents actually participate; the extent and character of resident responsibility for patient care, teaching, and research; the amount and character of feedback on performance regularly provided to each resident from senior residents, attending staff, and training chief. Observational data was obtained from site visits by the project staff. In the course of these two-day visits, a random sample of instructional experiences (rounds, conferences, seminars, operative and emergency room teaching) were described through carefully structured checklists and rating scales designed to document the quality of instructional exchange between trainees and their mentors, the educational goals (cognitive, psychomotor, effective) that the exchange is most likely to serve, and the pedagogic quality of the encounter (in terms of facilitation of learning, not the biomedical content).

3. Increasing Program Efficiency and Effectiveness. Through the intensive review described above, identification of areas in which new organization of training systems or

---

*See Supplement for site visit procedures.

utilization of alternative instructional modes would increase either a program's effectiveness of efficiency was made. Such changes included the following:

Staff Development Programs. A brief seminar on graduate education designed for attending staff and some of the intensive study programs was conducted during the second round of site visits. Almost uniformly the attendings from these programs voiced a desire for additional materials in the general field of educational science. Many attendings commented on the fact that these sessions were the first time in which they had dealt with educational principles without regard for the particular subject matter and clinical considerations in the hospital setting. Initially, two films illustrating the application (or violation) of fundamental principles of learning in characteristic educational settings (lectures, conferences, rounds operating room, and individual instruction) of residency training were prepared.* Their effectiveness resulted in the preparation of six additional films which were used on the subsequent site visits. These materials are available in the supplement.

Instructional Innovation**. One of the components of program efficiency is the appropriate utilization of a teaching staff. This utilization should appropriate highly skilled staff members to the task for which they are trained and avoid use of staff to accomplishing routine tasks for which another way is available. This rationale lay behind the type of instructional innovation promoted among the intensive study programs. Some of the instruction in plaster application, traction hanging, interpretation of x-rays, and the appropriate use and handling of orthopaedic surgical instruments is possible by organizing the Study. This type of study substitutes for the instructor a set of materials

---

*See Supplement for the folio of staff development materials.

**See also p. 13 for discussion of the task forces related to this area.

guiding the resident through the more elementary aspects of the subjects and allows the resident to procede through the set at his own pace and whenever he has the time. The instructor's time is thus saved from repetitious instruction for that instruction which only he can provide.

1. Radiology Teaching Package. The Radiology Teaching Package was an outgrowth of the material developed at the University of California at San Francisco by Doctor Steven Ross, a radiologist. Dr. Ross developed teaching materials in response to a number of needs that he saw in the field of ratiology teaching. The first was that the residents needed to be presented with radiological materials in the order of increasing difficulty so that in the learning process he was not encountered by the wide variety of trauma that entered the clinical situation but was able to progress from the more easily recognized cases to the more difficult ones. Secondly, that the resident could study these materials on an independent and self-paced basis. As a result of the interest of the Orthopaedic Training Study in his work Dr. Ross has begun development, with the assistance of the Orthopaedic Department of the University of California, San Francisco, of several sets of orthopaedic resident radiology teaching packages. The Orthopaedic Training Study itself, to determine the effectiveness of such a teaching method, has developed a four series set of materials which are designed to familiarize chiefs, attendings and residents with the concept, and provide a model for which they can develop their own teaching materials. The radiographic series we have developed, illustrating the various types of pathology, are given anatomic location with attached attenuating histories and obscured correct interpretations and bibliography viewed by the trainee only after he has committed himself to an interpretation of the films. Overlays are available for pre and post-testing and help to coordinate the description of fine and obscure detail.

2. Plaster Skills. It was observed in many of the programs that the basic principles underlying the use of plaster were never systematically presented to the resident. It was expected that he would obtain this knowledge from one or another of the attending staff involved but no attending was individually responsible for teaching it. Plaster skills, being one of the most basic of orthopaedic psychomotor skills was selected first in our development of psychomotor innovations. The initial phase of the plaster lab was developed by one of the six month Fellows in Orthopaedic Education, who had just completed his residency training program. Under his direction an intensive investigation of the literature and rationale that had been developed for psychomotor training, which came mostly from industry, was investigated and a pilot unit was prepared. This unit was then circulated to the intensive study programs during site visits and comments and suggestions about both the methodology involved and its potential value to residency training programs was solicited. One of the curious phenomenon which resulted from our site visits was that there was a divergence of opinion between residents and attendings about plaster skills instruction. Residents saw a real need for the plaster laboratory early in their training, but attendings felt that the instruction was given to all residents at some time. The attendings, while they understood the rationale presented, did not feel that the laboratory was a necessary adjunct to their programs. Upon discussion of the residents and attendings it became obvious that much of the instruction that the attendings took for granted as having been taught had been missed in many of the residents' training. Therefore, such a planned sequential program for every resident, seemed to the residents to be most desirable. After considerable discussion and laying of the evidence, the attendings arrived at the same conclusion. This discussion and consensus occurred in about 80 percent of the programs in the second round of site visits. Subsequently,

the total package of plaster skills was developed and expanded to a series of eight lessons which was then field tested in three of the intensive study programs. Based on their comments to date, the materials have been revised and reviewed by the chiefs of the programs in the intensive study group for further development.

3. Traction Laboratory. The second innovation to be developed was the traction laboratory. This innovation was developed by two residents, one of whom wrote the instructor's manual, while a second provided the ancillary (slides, tapes, etc.) material which were the actual instructional tools for the laboratory. Again, this was tried out in two of the intensive study programs. Comments and suggestions were then used to further refine the laboratory.

4. Psychomotor Skills - Surgical. Due to the perceived need for further development of the basic psychomotor skills needed by beginning orthopaedic residents, a task force was assembled to study the area of surgical technique and instrumentation which should be included in a basic surgical skills laboratory. After defining the instruments which would be considered, each of the participants selected an area to be developed both in the form of a sound slide presentation and a video tape of the dynamic aspects of instrument usage, rather than the static one, which could be demonstrated well on sound slides. It was decided to focus the laboratory around the use of particular instruments rather than around surgical procedures, both as a mechanism for the organization of individual study units independent of one another and for the simplification in the presentation of the large amount of information, considering the large number of individual instruments which could be used in any procedure. The focus on instruments themselves avoided a duplication of instrument usage in the various operative procedures. The instruments which were selected for development in the first

meeting were as follows: scalpel, needle holders and needles (suturing), hand saws, periosteal elevators, hand drills, drill bits, depth gauges, screw drivers, hemostats, rongeurs, wires, pin cutters, bending iron, wires and surgical pins, reamers, bone halters, rasps, osteotmee, curettes and gouges.

4. Relationship of Input Training and Output Variables. The Study produced, in 1967, a data bank with the guarantee of anonymity for any individual resident, that allows an investigation access to a continuous record of resident progress as it is assessed through annual In-Training Examination (OITE). Additionally, the data bank contains standardized perceptor ratings of resident achievement of knowledge, problem solving, and interpretive skills. Results of the Board Certifying Examination, which probes complex cognitive processes, professional behavior, and selected technical skills, are also part of the orthopaedic data bank.

The model chosen for the study design was borrowed from the economics model of input-process-output. The elements of each are examined individually; for example, the characterization of the input is considered first, with the resident's background, attitude, fund of knowledge, etc., with which he comes to the field of orthopaedics, then the method of which this individual is treated or processed through a program for example, the settings the hospitals and various kinds of service rotations, etc. These are then related individually to the output measures. Finally, a variety of statistical techniques are useful in studying the interaction between various elements of the input and processing or treatment.

INTERACTION
INPUT
Resident
background
attitude
etc.
TREATMENT
Setting
hospitals
patients
etc.
Program
rotations
service
etc.
Staff
attending
ancillary
etc.
output
drug
out
client's Rating

The analysis of the data was done at two levels. First, each of the many responses given by program chiefs, hospital administrators, attending staff, and residents, to the questionnaires were tabulated then summarized in the reports in Section II. Second, from the questionnaire results, hypotheses were generated at Advisory Committee Meetings, intensive study program chiefs' meetings, and personal observations of the Study Staff during site visits. These hypotheses stated expected relationships of characteristics of orthopaedic training program's facilities and organization, and characteristics and attitudes of residents and attendings to a criterion measure of resident performance. The criterion selected upon which to judge the success of a resident's education was the OITE total multiple choice score and the total PMP score. The hypotheses tested in this report are by no means exhaustive of the areas in which investigation is needed nor are they, in many instances, refined enough for the results to be applicable to any particular program. Further evaluations of program efficiency and effectiveness need to be carried out in individual training programs to assure applicability of results. However, the results of the hypothesis testing research presented here is the first effort to investigate training programs. As such, its purpose is to stimulate the orthopaedic and the educational research community to do further studies indicated by the trends and relationships uncovered by the present Study.

INTRODUCTION

One of the first tasks confronting the Advisory Committee and professional staff was the selection of the Study samples. The objectives of the Study (see page 2 & 3) suggest that data collection from the introduction of innovations be divided among three board classifications of programs.

1. Population: All programs would be asked to supply certain information, such as, program length, aims, and other characteristics (see Supplement for a list of all data collection instruments and by whom they were completed).

2. Survey Study Sample: A limited number of chiefs of programs (38) were invited to participate in data collection efforts which would be more extensive than in the population at large (see Supplement). Of those invited, 31 accepted the invitation to participate in the Study. The resulting group of programs was called the Survey Study Sample.

3. Intensive Study Sample: Sixteen program chiefs were invited to participate in an intensive study of their programs; all accepted. This group agreed to permit data gathering, not only about its program and institutions, but about residents and attendings as well. They also agreed to participate in the development and trial of innovative methods of instruction which were developed by the Study staff.

Both of the samples (2 and 3 above) were selected by the Advisory Committee in conjunction with the Study staff in order to reflect a similar ratio of a number of characteristics believed to influence the quality of orthopaedic education as would be found in the total resident training program population.

It was intended to provide two samples that would reflect, among others, the variations in program size, geographic location, institution type (university, university-affiliated, or independent), numbers and types of affiliated institutions, program mission, patient composition, and program length similar to those found in the total group or population.

The extent to which programs cooperated can be seen from the rate of return for the various data collection instruments (see Supplement).

II -- NATURE AND VARIATION
A - PROGRAMS

In the Final Report of the Phase I of the Orthopaedic Training Study, four areas were suggested for a description of program variation in orthopaedic training: program organization, program objectives, program operation, and program evaluation. These areas will serve as a basis for the following description of the nature and variation of orthopaedic training programs presently existing in the United States. In addition, an attempt will be made to characterize a typical university, university-affiliated, or independent program.

The same Program Questionnaire (see Supplement) was administered twice to directors of all the 187 approved orthopaedic residency programs. There were 150 responses in 1969 and 131 in 1971. In addition, there were 116 responses to the Institutional Description Form from approximately 200 institutions associated with the 51 programs included in the Orthopaedic Training Study sample. The Program Questionnaires will be the main source for information in this section of the report. However, the information from the 131 Program Questionnaires returned from the 1971 administration will be reported in this analysis only when they reveal apparent differences between the earlier 1969 results and the 1971 results.

In the main, however, there did not seem to be much change in orthopaedic training from 1969 to the present time as reported by these questionnaires. This is not particularly surprising as institutional change traditionally occurs slowly. It is important to note, at this juncture, that where changes are indicated, the interpretation of these results must be speculative in nature. Nineteen fewer programs responded to the administration of the Program Questionnaire in 1971, and it may be that the apparent changing results are a function of non-response rather than of actual sample differences. With this reservation, where changes are apparent, they will be indicated in this analysis.

PROGRAM ORGANIZATION

This section of the report deals with the personnel, facilities, and resources of the Orthopaedic Training Programs and their associated institutions in the sample. Unless otherwise specified, the statistics presented in this section of the report refer to all programs in the Study sample.

It should be noted that this section of the report is concerned with a description of a typical orthopaedic program, without regard to program type differences. The final pages of this section detail the differences among types of orthopaedic programs in the hopes of further highlighting variations in residency programs.

GENERAL PROGRAM CHARACTERISTICS

Approximately 40 percent of all approved programs from the 1969 sample and 47 percent from the 1971 sample identify themselves as university programs.[1] Approximately 29 percent of the programs identify themselves as affiliated with either a medical school or a university,[2] while 29 percent of the programs in 1969 and 23 percent in 1971 identify themselves as independent programs.[3] (It should be noted that these percentages are based upon the description of the program type by the chief of the program.) It is somewhat more common for university programs to be organized as a division within the department of surgery than as a separate department; while independent programs are more likely to identify themselves as departments of orthopaedic surgery in non-university hospitals. In 70 percent of all the programs, the chief has academic rank, though not necessarily tenure. This indicates that almost all of the chiefs of university and affiliated programs have academic appointments. Sixty percent of the chiefs have offices located in the principal

---

[1]Typically, university programs are those orthopaedic programs which are an integral part of a university with the attending staff having university appointments.

[2]Typically, university-affiliated programs are those orthopaedic programs which are connected to a university or medical school through a variety of formal arrangements. The attending staff of these programs may hold university appointments.

[3]Typically, independent programs are those orthopaedic programs which have no formal connections with a university nor are their staffs drawn from university faculties.

institution of the program. In slightly over one-third of the programs, the bulk of the chief's income derives from salary; while in an almost equal number, the chief receives virtually no income from that source.

Eighty percent of the programs embrace several associated institutions usually within the immediate geographic area. These associated facilities are likely to include a private community hospital (in 70% of programs reporting), a "crippled children's" hospital (in 62%), a Veterans' Administration Hospital (in 44% of the cases in 1969 and 50% in 1971), and a "charity" hospital (in 43%).

Even in these multi-institutional programs, the chief of the program often retains direct control over all aspects of the program. However, in approximately half of the programs, some of the control is delegated to chiefs of service of constituent institutions, and in approximately one-fourth of the reporting programs, the chief of service is reported to be completely independent of the program chief. Similarly, even though training is distributed through several institutions, the resident is likely to encounter substantially the same attending staff in all associated institutions; only slightly more than one-third of the programs report a substantially different staff in each associated institution.

With respect to the general characteristics of the associated institutions, almost one-third identify themselves as private hospitals.[4] Another third of the institutions are about evenly divided in identifying themselves as university hospitals and public hospitals of the city-county type. The balance of the institutions report being hospitals which represent some combination of the preceding, and by military, VA, and other non-profit organizational hospitals.

The board of directors is wholly appointed for over 40 percent of these institutions. In less than 10 percent of

---

[4]One hundred sixteen institutions are included in this analysis, which constitutes approximately 50 percent of the institutions associated with programs in the study sample. The Institutional Description Form was administered only once, in 1969.

the cases, the boards include members elected from the community-at-large. Almost three-fourths of the institutions employ a professional hospital administrator; most of the rest have a physician administrator. The medical staff administration is elected from the staff-at-large in 37 percent, and is limited to chiefs of services in 34 percent of the institutions.

Most of the institutions associated with programs in the study sample rely on multiple sources of support. Indeed, only four percent of the institutions obtain total support from private foundations and only 10 percent report that they receive no government funds for any purpose. Over one-third of the institutions report that more than 50 percent of their support is obtained from governmental sources (federal, state, and local), while almost half report that over 50 percent of their budget is derived from patient fees. Four percent of the institutions report that over 50 percent of their support comes from university budgets.

PERSONNEL

While some programs have fewer than five residents and six attendings and others more than 60 and 80 respectively, most reported between six and 12 residents in 1969. These numbers increased to between seven and 16 residents in 1971. In 1969, the bulk of the programs reported having between five and 20 attending staff members, while the numbers increased in 1971 to between seven and 21. In the "typical" program in 1969, there were eight residents, 11 attendings, and no research or clinical fellows, while in 1971, the "typical" program was comprised of 11 residents and 12 attendings.[5] This increase in number of residents in a typical program may be attributable to pressure on the medical community to develop more trained physicians as well as the increasing attractiveness of the specialty of orthopaedics.

---

[5]Only 20 percent of the programs reported any fellowship staff and no program reported more than four on the fellowship staff.

In addition to a full range of medical specialists available as professional consultants in virtually all programs, the subspecialties most often represented by the orthopaedic attending staff are hand surgery, orthopaedic pathology, pediatric orthopaedics, spine, and rehabilitation. Table 1 presents information concerning the percentage of programs reporting at least one subspecialist in their program within a particular category. The table should be interpreted in terms of programs indicating the presence of subspecialists, not in terms of numbers of subspecialists within a particular program.

TABLE II - 1

PROGRAMS REPORTING SUBSPECIALISTS
(Percentages)

	1969	1971
Rehabilitation	49.0	53.0
Bio-mechanics	20.0	32.0
Orthopaedic Pathology	59.0	63.0
Hand Surgery	76.0	84.0
Neurologic disorders	30.0	31.0
Pediatric Orthopaedics	59.0	73.0
Spine	53.0	58.0
Other subspecialists	15.0	9.0
None	9.0	5.0

Table 1 indicates that the trend toward specialization within the general field of medicine is also evidenced within the field of orthopaedics. This is interesting, since this specialization trend is noticeable within a space of only two years. Especially noteworthy is the increase in programs reporting bio-mechanics and pediatric orthopaedics as subdisciplines represented by specialists on the attending staffs.

In addition to the subspecialists represented on the attending staff, these programs report that allied health personnel afford the programs additional specialties. Ninety-nine percent of the programs report physical therapists comprising

part of their allied health staff, while 95 percent of the programs have social workers on the ancillary staff. Over 80 percent of the programs report prosthetists, orthotists, and occupational therapists as comprising part of their allied health personnel. Additionally, over 80 percent of the programs report psychiatrists as part of the program personnel.

Other supporting services within the institutions associated with the sample programs are most likely to include a nursing supervisor for in-patient services (in 98% of the institutions reporting), for the operating suite (in 97% of the institutions), for the emergency room (in 65% of the institutions), and for the out-patient service (in 68% of the institutions. An administrative supervisor is slightly less frequently available. For both in-patient and out-patient services, the administrative supervisor is available in 80 percent of the institutions. This percentage drops to 60 for the operating room and 50 percent for the emergency room. Eighty percent of the out-patient clinics have a registered nurse, but less than half have practical nurses, orderlies, plaster technicians or social workers, assigned solely to the orthopaedic clinic. Additionally, one is least likely to find psychological services (available in 43% of the institutions), counseling services for vocational rehabilitation (in 39% of the cases), and home nursing services (in 41% of the institutions) as part of the support services within the institutions associated with the programs in the Study sample.

FACILITIES

In addition to both the general orthopaedic and children's clinics found in virtually all programs, most programs report the following out-patient subspecialty clinics as also available in at least one institution associated with the program: fracture (in 87% of the reporting programs), amputation and prosthetics (in 77% of the programs), arthritis (in 60% of the programs), and scoliosis (in 52% of the 1969 responding programs and in 63% of the 1971 responding programs). However, only 40 percent of the programs report a long-term follow-up clinic where patients treated five years in the past are brought back for review.

With respect to the institutions associated with programs in the Study sample, the types of facilities most commonly included as part of the institutional structure are the following:

Out-Patient Services: About one-half of the institutions associated with the Study programs report orthopaedic subspecialty clinics. The most frequently encountered clinic was a hand clinic, with 72 percent of the institutions reporting this subspecialty. The presence of amputation prosthetics and children's subspecialty clinics were reported by 70 and 65 percent of the institutions respectively, while a special arthritis clinic was reported by about one-half of the institutions.

In-Patient Services: The institutions associated with the study programs reported that the average number of beds available to all services is 511, and to the orthopaedic service, 64.[6] While 44 percent of the institutions report that they have no private, single-bed rooms, such facilities account for over one-half of the orthopaedic beds in 40 percent of the institutions.

Seventy-six percent of the institutions report in-patients with fracture problems; almost two-thirds report in-patients with other trauma problems and hand problems. However, only slightly more than one-half report in-patients with rehabilitation and arthritic problems.

In approximately one-third of the institutions, admission for both private and non-private patients are scheduled according to general bed availability. Only three percent of the institutions report that patients are screened for admission strictly according to the teaching value of their problems, though an additional 21 percent report less strict application of this screening criterion. In 58 percent of the reporting institutions, residents do not have authority to arrange for admissions.

---

[6]To the extent that respondents failed to answer all questions, these figures may represent an underestimate.

The mean autopsy rate for these institutions is 48 percent and that for the orthopaedic services is 43 percent.

Surgical Facilities: The mean number of operating rooms in a sample institution is eight. The mean number of rooms assigned specifically to orthopaedics is one. In 67 percent of the reporting institutions, the individual surgeon schedules his own elective cases. In 84 percent, he schedules his emergency cases, while in nine percent of the institutions, scheduling of emergency cases is done through a chief surgical officer. In 63 percent of the institutions, orthopaedics is assigned specific operating days. The operating room is under hospital control in half of these institutions, general surgery control in 22 percent and individual specialty control in 12 percent of the reporting institutions. Fifteen percent of the institutions assign nursing and technical personnel according to general availability. Approximately three-fourths of the institutions report having an adequate assortment of surgical equipment and appliances readily available, though 11 percent require special purchase of endoprosthetic devices and three percent require that the surgeon supply his own instruments. All institutions have x-ray facilities available in the operating room, while 23 percent have this type of equipment and technicians assigned specifically to the operating room routinely. In 53 percent of the institutions, anesthesiologists administer all general anesthesia. Only nine percent of the institutions have nurse anesthetists who work without supervision of an anesthesiologist. Finally, in 73 percent of the institutions, both the surgical and anesthesia services administer regional anesthetics.

Supporting Services: Satisfaction with the quality of supporting facilities was most likely to be reported for medical and nursing administration (in approximately 90% of the institutions), and for x-ray, special laboratory, prosthetics and physical therapy facilities (in 80 to 85% of the institutions). Social service, occupational therapy and orthotics were viewed as adequate or superior in 60 to 70 percent of the institutions: while research, school facilities for patients, convalescent, psychiatric counseling, and vocational rehabilitation were most often reported as unavailable or inadequate by 40 to 50 percent of the institutions.

Although approximately one-third of the institutions have formal arrangements or affiliation with convalescent and custodial care facilities, the majority do not have such arrangements. In fact, at least three percent of the institutions are in communities where no such facilities exist.

Record Facilities: Over two-thirds of the reporting institutions have the capability of retrieving in-patient charts according to diagnosis or treatment, whereas only one-third can retrieve out-patient records in this manner.

Library Facilities: Whereas 80 percent of the institutions have a medical school library available, only about one-half have an orthopaedic departmental library available to the residents for at least eight hours daily. More than half of the libraries used by the residents are relatively small, fewer than one-sixth reporting collections of over 75,000 volumes.

Secretarial Service: Approximately three-fourths of institutions report that such services are available to house staff for in-patient records and activities, while two-thirds report such facilities available for out-patient activities. One-quarter of the institutions report clerical support for research endeavors. Almost one-third report liaison personnel for community resources. Less than 10 percent report no clerical support available.

RESOURCES

One of the vital resources of any orthopaedic training program is the patient population. In this section of the report, we will attempt to summarize the variations in patient population and the resultant implications of this variation for residency programs.

Size of Patient Population: The average number of out-patient visits to orthopaedic clinics is 3,858 although the

number varies significantly from one institution to another within a program.[7]

In addition to the orthopaedic clinic, about half the institutions include a separate arthritis clinic in which the main number of annual out-patient visits is 454. Finally, the average number of annual out-patient visits in the medical and surgical clinics of responding institutions is 17,562 and 15,767 respectively.

Clinical Variety: Despite differences among institutions in the pattern of administrative responsibility for patient care, a few widely applicable generalizations can be made. Approximately 80 to 90 percent of the institutions report that the orthopaedic department assumes administrative control over patients with the following problems: fractures, musculoskeletal tumors and amputations occasioned by other than peripheral vascular disease. It is interesting to note that in approximately one-fourth of the institutions, the orthopaedic department also assumes administrative responsibility for patients with lumbar disc, hand problems, chronic spinal cord injuries, or rehabilitative cases requiring long-term care. Finally, in between 10 and 15 percent of the institutions, the orthopaedic department assumes administrative responsibility for patients with arthritis, cervical disc, acute spinal cord injuries, or for patients requiring amputation due to peripheral vascular disease.

Most programs report that the most frequently encountered problem is trauma, representing up to 60 percent of all patient problems in a few programs. Rehabilitation problems are least common, representing less than 20 percent of all patient problems in most programs.

Age Distribution: In hospital settings other than those limited to specified groups (military, veterans, or children), the most frequent pattern with respect to the age distribution of the patient population is that 80 percent are adults and 20 percent are children. This picture is characteristic of

---

[7] To the extent that respondents failed to answer all questions, these figures may represent an underestimate.

over 40 percent of all institutions to which residents are assigned.

Residential Distribution: Over one-third of the institutions in the Study sample serve patients who reside in metropolitan areas of over one million persons. Fewer than 10 percent of these institutions serve predominantly rural populations of under 10,000 people, while most of the remaining serve patients from urban centers of between 100,000 to 500,000 people.

Socio-Economic Status: Although the ratio between private and non-private patients varies significantly among programs, only eight percent of the programs report no "private" patients available in the entire program, and only one percent report no "non-private" patients.[8] Secondly, whether the private or the non-private patient predominates in a particular program, that type usually constitutes no more than 80 percent of the total patient population. In short, it would appear that most programs serve patients from various socio-economic levels. However, the opportunity for an individual resident within a program to gain experience with patients of various socio-economic levels is dependent upon the specific rotations available. Thirty-seven percent of the institutions report that they deal predominantly with patients in the lower socio-economic groups.[9] Indeed, over a fifth of all institutions report that they serve predominantly indigent populations and another seven percent serve predominantly Medicare patients. Of the remainder, 51 percent of all institutions report that more than half of their

---

[8]Private patients are, in general, patients who are billed directly by their attending physician for services rendered. Non-private patients are, in general, patients who are not billed directly by the responsible physician.

[9]This category was not defined in the Institutional Description Form, and hence, it is not possible to state the income boundaries of this designation.

private patients have care financed through insurance plans, and only four percent of the institutions report that between 20 to 60 percent of these patients finance their care wholly from private resources.

In addition to this economic diversity in the patient population, 60 percent of the institutions report that they serve non-English speaking patients to some degree. However, there is an interpreter available in slightly more than one-half of those institutions reporting a substantial number of non-English speaking patients.

Approximately one-half of the institutions report that there is a communications problem between patients and residents. This may, in part, reflect the disparity between the socio-economic and ethnic backgrounds of the patient population and that of the resident staff.

It is clear from the foregoing that the kinds of clinical problems and the varieties of socio-economic groups to which the resident is exposed depends almost entirely on the nature and location of the institution in which he is trained. Less than one-fourth of the institutions report that they do screening for the educational value of the medical problem.

PROGRAM OBJECTIVES

Orthopaedic training programs have both medical and educational objectives which are said to direct the functioning of the program operations. Eighty-four percent of the programs report that their primary objective is to "produce clinicians oriented to community practice". The production of subspecialists or academicians is ranked as the primary objective by only 15 percent of the programs. The production of research-oriented orthopaedists is regarded as of first importance by only one percent of the programs, while slightly over one-half rank this objective as third in priority.

The most frequently encountered educational pattern, characteristic of almost one-half of all programs, consists in four years of orthopaedics following internship, although approximately one-third of the programs offer a three year orthopaedic residency following 12 months of general surgery.

Nearly half the programs offer complete training in orthopaedics plus options for development of more specialized interests. Virtually, all others offer complete training in orthopaedics as standardly defined.[10]

Two-thirds of the programs include a rotation in neurosurgery sometime during the four years and over one-half include rotation in plastic surgery. The sample from 1969 reported that, in 53 percent of the programs, a rotation in "trauma" was also offered, while the 1971 sample reported this rotation available in 65 percent of the programs.

Typically, clinical teaching includes the following types of activities on a regularly scheduled basis: didactic instruction, bedside teaching rounds, group conferences, work rounds, surgical experience and out-patient and specialty clinics supervised by an attending. In 77 percent of the programs, basic science instruction is offered within the program and this instruction is distributed throughout the four years. In approximately one-third of the reporting programs in 1969, the resident was required to submit a research paper, and in all but a few of these programs, he is expected to carry on his investigation and clinical work concurrently. In 1971, the percentage of programs requiring a research paper increased to 45 percent.

In order to determine if this apparent increase in emphasis on research was an artifact of the differences in samples between the two years, a re-analysis of the results were undertaken using only programs which had responded to both of the questionnaire administrations. The 117 institutions which responded to both the 1969 and 1971 questionnaires showed an increase in emphasis on research. Thirty-six percent of these programs reported that a research paper was mandatory in 1969, while that figure is 42 percent in 1971. However, despite the increased emphasis on the submission of a research paper, there is not a corresponding increase in the percentage of programs allotting specific time for work on the paper.

---

[10]Standardly defined training involves complying with the requirements of the Board.

In about two-thirds of the programs reporting in 1969 and 78 percent reporting in 1971, presentation of papers at national meetings is actively encouraged. These percentages were identical when the 117 programs responding to the 1969 and 1971 questionnaire administration were analyzed.

Attendance at one (or more) annual national meeting was mandatory in 53 percent of the programs in 1969 and in 61 percent of the programs reporting in 1971.

There appears, then, to be a trend toward increased resident participation in research activities in residency programs, even over the short time of two years. This trend may have implications for objectives, further program directions, and allocations of resources within the orthopaedic community.

PROGRAM OPERATION AND EVALUATION

The variations in program operations are undoubtedly a function of the organization and objectives of the program. As a consequence, this section of the report connects the previous material with information about resident responsibility, in terms of teaching and patient care, and with feedback and supervision mechanisms.

Resident Teaching Responsibilities: In most programs, the resident is expected to participate in the instruction not only of other residents and interns, but also of medical students (in 60% of the programs reporting in 1969 and in 67% reporting in 1971), and of allied health professionals including nurses and physical therapists.

Resident Patient Care Responsibilities: Table 2 presents data illustrating the responsibility of residents for patient care over the length of the residency. Eighty-eight percent of the program chiefs report that residents begin performing simple orthopaedic operations in the first year of training and progress systematically toward the more complex procedures with increments in experience. It is clear, however, from Table 2 that that first-year residents in some programs are expected to assume a level of responsibility that fourth-year

residents in other programs never assume. Thus, for example, while residents in most programs can expect to assume full medical responsibility for frequently encountered types of surgical trauma sometime between late in their second-year and early in their fourth-year, three percent of the chiefs report that such responsibility is usually assumed by first-year residents and five percent of the chiefs report that such responsibility is never assumed by residents.

It is evident, then, that there is a rate differential among programs in the level of responsibility allocated to residents.

It is clear, also, from Table 2 that there has been an increase in providing residents with more responsibility earlier in their residency from 1969 to 1971. There are substantial increases in resident responsibility displayed on this table, such as, the increase from 39 percent in 1969 to 59 percent in 1971 of programs reporting that first-year residents are responsible for out-patient trauma cases. This increase could not be accounted for solely by idiosyncrasies of the responding programs in the 1971 sample. In every case, without reversal, there was an increase in responsibility assumed by residents at each type of orthopaedic procedure.

SUPERVISION AND FEEDBACK

In approximately two-thirds of the programs, chiefs report that actual supervision of residents in the operating room is provided in accord with the needs of the individual resident. In the rest of the program, actual supervision in surgery is provided for all cases regardless of complexity. Finally, 89 percent of the chiefs report that residents are regularly advised of their rate of progress and their areas of deficiency.

SUMMARY

The preceding section has attempted to describe orthopaedic training programs with major emphasis on the nature and variation of these programs in terms of facilities, personnel, organization, and resources. Less information was presented concerning the objectives, feedback mechanisms, and

evaluative procedures employed by the programs. It would seem that future studies along these lines might be most productive if these relatively unexplored aspects of training programs were thoroughly investigated.

A PROGRAM TYPOLOGY

In order to more clearly depict the nature and variation of orthopaedic residency programs, a typology of programs was developed based on the affiliation dimension of program organization. That is, a characterization of a typical university, university-affiliated, and independent program was created. Table 3 displays that characterization.

The university programs appear to have more available facilities and resources than the other two types of programs. There are more out-patient clinics, subspecialists, and associated hospital facilities available to university programs than university-affiliated and independent programs. University programs also tend to supervise resident training more closely and wait longer to give residents patient care responsibility for simple orthopaedic procedures. It is also a characteristic of university programs that residents are permitted to become involved in special interest areas and are encouraged to give papers at annual meetings.

University programs tend to be more similar to university-affiliated porgrams than are either of these types to independent programs. These differences are particularly apparent with respect to general organization and administration. These differences tend to disappear with respect to resident training per se.

Independent programs are characterized by more authority vested in the chief of the program than chief of staff, by an emphasis on internship performance as a criterion for admission to the program, and by fewer additionally required rotations for residents. Additionally, independent programs have fewer supspecialists, associated facilities, and out-patient clinics than university or university-affiliated programs. Independent programs permit residents to assume non-surgical patient care responsibilities early in their residency but maintain closer supervision for surgery at all levels of competency. Finally,

these programs are characterized by comparatively more emphasis on attendance at annual meetings and optional research papers, and with higher pay for the resident staff.

It should be noted that, in general, the characterization of the three types of programs are quite similar. There are standard facilities and resources available irrespective of program type, admissions criteria which are accepted in all three types of programs, and educational objectives and mechanisms for accomplishing these objectives which appear to remain similar throughout orthopaedic residency programs.

TABLE II - 2

RESIDENT PATIENT CARE RESPONSIBILITY BY YEAR IN TRAINING*
(Percentages)

	Year in Training					
	1	2	3	4	5	Never
Frequently encountered types of "out-patient" trauma (e.g., simple metatarsal fracture)	39.0 (54.0)+	41.0 (31.0)	3.0 (11.0)	1.0 (2.0)	0.0 (0.0)	1.0 (0.0)
Frequently encountered types of "in-patient" but non-operative trauma (e.g., fracture of pelvis)	19.0 (21.0)	40.0 (47.0)	30.0 (18.0)	9.0 (9.0)	1.0 (0.0)	1.0 (1.0)
Frequently encountered types of surgical trauma (e.g., hip fracture)	3.0 (2.0)	17.0 (27.0)	50.0 (43.0)	23.0 (20.0)	2.0 (3.0)	5.0 (2.0)
Simple reconstructive surgical procedures (e.g., elective bunionectomy)	3.0 (5.0)	31.0 (33.0)	45.0 (45.0)	16.0 (11.0)	1.0 (2.0)	5.0 (3.0)
Complex reconstructive surgical proglems (e.g., hip arthoplasty)	0.0 (0.0)	0.0 (2.0)	16.0 (23.0)	65.0 (57.0)	4.0 (5.0)	12.0 (11.0)

*The chiefs on the program were to state the earliest year of Residency in which responsibility was first given to residents.

+1971 results

TABLE II - 3

PROGRAM CHARACTERISTICS BY TYPE OF PROGRAM

	Program Characteristic	Type of Program		
		University	University-Affiliated	Independent
Organization	Program Status (1)*	Division of department of surgery in a public university	Department of Orthopaedic Surgery in a non-university hospital affiliated with a public university	Department of Orthopaedic Surgery in a non-university hospital
	Associated hospitals (4)	Several hospitals	Several hospitals	Several hospitals
Administration	Function of Program chief (5)	Partial control to chiefs of service	Partial control to chiefs of service	Direct control
	Position of Program chief (7)	Academic rank and tenure	Academic rank	No academic rank
	Location of Program chief (8)	Office in principal institution	Office in principal institution	A mile from princip institution
	Position of Chief of Service (9)	Academic rank	Academic rank	Belongs to practice group of chief of program
	Income limits on staff (11)	Limits	No limits	No limits
Resources	Allied health personnel** (24)	Physical therapist, social worker, prosthetist, orthotist, psychiatrists, occupational therapists	Physical therapist, social worker, prosthetist, orthotist, psychiatrists, occupational therapists	Physical therapist, prosthetist, social worker, orthotist, psychiatrists, occupational therapists
	Consultants (25)	Full range	Full range	Full range
	Special required rotations** (32)	Neurosurgery	Neurosurgery, plastic surgery, trauma	Neurosurgery
	Out-patient clinics** (33)	General, children's, fracture, amputation, prosthetics, arthritis, scoliosis	General, children's, fracture, amputation, prosthetics	General, children's fracture, amputation, prosthetics

*Question number from Questionnaire Program.

**Listed in order of frequency of response.

TABLE II - 3 (Cont'd)

PROGRAM CHARACTERISTICS BY TYPE OF PROGRAM

	Program Characteristic	Type of Program: University	University-Affiliated	Independent
Re-sources	Staff Subspecialists** (35)*	Hand, pediatrics, ortho-pathology, spine, rehabilitation	Hand, pediatrics, ortho-pathology rehabilitation	Hand
Facili-ties	Facilities** (36)	Private community hospitals, crippled children's, VA, charity (public) hospitals	Private community hospitals, crippled children's hospitals	Private community hospitals, crippled children's hospitals
Attend-ings	Attendings responsibility (13)	Formal teaching and clinical work	Formal teaching and clinical work	Formal teaching
Objec-tives	Objectives (29)	Community practice orthopaedics and subspecialists, academicians	Community practice	Community practice
Resident Education	Admissions criteria** (19)	Medical school standing, intern performance, intellectual approach to problems	Medical school standing, intern performance, intellectual approach to problems	Intern performance, intellectual approach to problems
	Program length (26)	Four years	Four years	Four years
	Program continuity (28)	Training in more than one institution, but same staff	Training in more than one institution, with different staff	Training in more than one institution, same staff
	Clinical sources (30)	Non-private patients	Non-private patients	Split between private/non-private
	Clinical variety** (31)	Trauma, adult, general, pediatrics, rehabilitation	Adult, general, trauma, pediatrics, rehabilitation	Trauma, general, pediatrics, rehabilitation
	Basic science (38)	Integral	Integral	Integral
	Resident's teaching responsibility (39)	Medical student residents, interns, allied health	Residents, interns, allied health, medical students	Residents, interns, allied health

*Question number from Questionnaire Program.

**Listed in order of frequency of response.

TABLE II - 3 (Cont'd)

PROGRAM CHARACTERISTICS BY TYPE OF PROGRAM

	Program Characteristic	Type of Program		
		University	University-Affiliated	Independent
Resident Education	Program design (27)*	Orthopaedics and options for special interests	Orthopaedics	Orthopaedics
	Research paper (40)	Optional	Optional	Optional
	Meeting attendance (42)	Encourage papers	Encourage papers	Meetings mandatory
	Supervision training (43)	Close	When necessary	Close
	Operative supervision (47)	According to need	According to need	All cases
	Patient care responsibility (46)	Systematic progression in performance	Systematic progression in performance	Systematic progression in performance
	Operative responsibility (45)	Complete by 4th year	Complete by 4th year	Complete by 4th year
	Diagnostic report to residents (44)	Advised of progress	Advised of progress	Advised of progress
Resident Income	Resident first two year salary (20)	$5,000 - 7,500	$7,500 - 10,000	$5,000 - 10,000
	Resident second two year salary (20)	$5,000 - 10,000	$7,500 or more	$7,500 or more

*Question number from Questionnaire Program.

**Listed in order of frequency of response.

II - NATURE AND VARIATION
B - RESIDENTS AND ATTENDINGS

The Typical Orthopaedic Resident

The typical orthopaedic resident identified by the Study is 30 years old, male, married, Caucasian, has one or two children, comes from the Midwest or Middle Atlantic states, frequently has a father or uncle who is an M.D., and often a wife, sister, or mother in a health-related occupation, usually nursing. His educational background and his family's economic status are well above average. One-third of the residents have fathers with a professional degree and one-fourth have mothers with a college degree; 75 percent have fathers in executive or professional positions; 52 percent have fathers who are self-employed. The resident is among the intellectual elite; nearly half of the resident population in the Study sample were in the upper five percent of their high school class; over two-thirds were in the upper quarter of their college class; and nearly half were in the upper quarter of their medical school class.

A desire for independence, an interest in science, in people, and in the workings of the body, and the prestige of the profession were strong influences in his selection of medicine as a profession--a decision he probably made about the time of high school graduation. Of little importance were books or articles, movies about medicine, or previous vocational guidance. The nature of the specialty and of the clinical material, a desire to perform surgery, an ability to work with his hands, and his experiences during the internship were strong determinants in his choice of orthopaedics as a career--a decision he tended to delay until his internship year.

In general, reputation of the institution and its geographical location, as well as financial considerations, played a major role in his choice of both a medical school and a residency program. However, in selecting the latter, he was also influenced by his desire to work with a particular person and by his associations or experiences in medical school. Over 80 percent of the residents report that they were appointed to the program of their first choice; only five percent report that they were appointed to a program of third choice or lower. Approximately 60 percent of residents indicated at the time of the survey that they aspire

to private practice in a small orthopaedic clinic and that they hope to have some medical school affiliation and do some teaching.

In order to gain further insight into the variations of the background of residents, the following description of an atypical resident is presented. All of the characteristics mentioned do not necessarily describe any one individual or set of individuals, but they exist in the population under study. These characteristics highlight the range of responses rather than the mean or average response on which the typical resident description is based.

The Atypical Orthopaedic Resident

The atypical orthopaedic resident could be 25 years old (the age of most senior medical students) or 37 years old in his sixth year of training (the age of two chiefs of orthopaedic programs). He could soon be among the more than 60 residents who left orthopaedics or changed to another program during the last five years, more than half of whom were dismissed for irresponsibility (moral or ethical) or poor clinical judgment. His father may not have completed high school, as was the case with almost 20 percent of the residents, while his parental family income last year was probably less than $7,500, and his family's economic position last year was lower than it was 10 years ago. Seven percent of the residents have accumulated over $10,000 in educational debts while one percent earned less than $4,000 as a senior resident. The atypical resident may be among the three percent who maintained a straight C average through high school, college, and medical school, and did not take any biology courses in high school (5%) or college (1%), still he was able to become an orthopaedic resident (even though he was admitted to a program which was his third or lower choice (5%). He could have decided to study medicine at age 27 and orthopaedics at age 34. He could have elected medicine at age six and decided on orthopaedics as a college freshman at age 18. A majority have seriously considered another profession. Consequently, our atypical resident might have become an educator (7%), business administrator or lawyer (each 4%), forester or aeronautical engineer (each 3%) or mathematician (2%). He may be among the 29 percent who read

medical literature for less than 10 hours a week and spend more time than that in employment outside the residency (12%). In fact, almost one-third of the residents reported that they do work outside the residency in an area directly related to medicine, while this practice is expressly forbidden by most training programs.

Resident Attitudes

As shown in tables 7 and 8, between 70 and 85 percent of the residents whose attitudes were surveyed showed a satisfaction with many aspects of their residency program and with the staff and residents with whom they work. They do, however, have some complaints about hospital procedures.** Their responses can be summarized in three categories, as follows:

1. Satisfaction with attendings as teachers. (See table 4).

2. Acceptance of responsibility to teach students and the satisfaction with the personal benefits of having to teach (improving technique with the extra practice and preparation by extra reading). (See table 5).

3. Dissatisfaction with hospital procedures which waste resident's time ("scut work", excessive night duty, services which are inadequate or available only with much difficulty).** (See table 6).

**Residents are equally divided on this issue, i.e., as many are satisfied as are dissatisfied.

TABLE II - 4

Satisfaction with Attendings As Teachers

1. The full-time faculty in my department understands and appreciates the contributions of the resident.
2. I have sufficient opportunity to work closely with the senior (attending) staff.
3. The attendings in my department exert a strong effort toward making the resident's experience a valuable one.
4. My department is generally regarded as having a "stimulating" teaching staff.
5. It was known to the residents that this residency program had been organized with specific objectives in mind.
6. The full-time staff in my department places great emphasis on the practical management of problems.
7. Attendings consciously strive to improve their performance as teachers.
8. Residents are helped to understand the source of important problems they may be facing.
9. When I began my assignment on this specialty, the resident's role was made clear to me.
10. Constructive suggestions are offered to residents in dealing with their major problems.
11. Evaluation of the residents goes on constantly.
12. If I had it to do over again, I would select this residency program.
13. The different skills found in the attendings are fully utilized.
14. Most of what I have learned thus far has been supervised to my satisfaction.
15. The attending staff is sufficiently aware of my performance to render an accurate evaluation of my work.

TABLE II - 5

Resident Teaching Responsibilities

1. Students on my service do not hinder the performance of my duties.

2. Having students around causes me to "read up" more than I might have done otherwise.

3. Having to teach does not take time away from more important things I want to do.

4. The presence of students on my service makes it a better "teaching service."

5. I now believe this residency would be worse without students.

6. Teaching students how to perform certain procedures helps to improve my own technique.

7. Residents play a major role in teaching.

8. The presence of students probably affects my learning one way or the other.

9. My service is student-oriented.

TABLE II - 6

Dissatisfaction with Hospital Procedures

1. Time spent arranging to have laboratory tests done detracts from time I could use on some more productive areas.

2. Residents do too many menial tasks on my service.

3. Residents are exploited by the hospital and its attending physicians.

4. I feel that the resident's assignments are determined primarily by a need to provide "service" to patients.

5. Paramedical personnel have too much control over a resident's activities.

6. I have too much night duty.

7. Clinical laboratory services are inadequate and available with too much difficulty.

8. Demands on the residents are so great they are almost impossible to meet.

TABLE II - 7

Many of the residents who responded to the survey AGREED with the following statements:

Eighty-five Percent Agreement:

Regularly scheduled resident meetings are a valuable educational activity.

Most residents here make an effort to keep up with the current medical literature.

Residents are open and free about exchanging information.

The residents get along together socially.

Seventy Percent Agreement:

Residents play a major role in teaching on my service.

I have sufficient opportunity to work closely with the senior (attending) staff.

The attendings in my department exert a strong effort toward making the resident's experience a valuable one.

Residents have the feeling that their work is an important activity.

The full-time staff in my department places great emphasis on the practical management of problems.

There is a congenial relationship between most of the attendings and residents on my service.

Teaching students how to perform certain procedures helps to improve my own technique.

Constructive suggestions are offered to residents in dealing with their major problems.

Evaluation of the residents goes on constantly.

TABLE II - 7 (Cont'd)

Residents are willing to help out when a fellow resident has a great deal of work to do.

I have sufficient opportunity to develop and use my clinical skills during residency.

If I had it to do over again, I would select this residency program.

TABLE II - 8

More than 70 percent of the residents who responded to the survey DISAGREED with the following statements:

Evaluation of a resident is based primarily on surgical skill.

Students on my service hinder the performance of my duties.

Residents do too much research.

The morale of the resident staff is low.

The number of private patients on my service is inadequate.

Having to teach takes time away from more important things I want to do.

I now believe this residency would be better without students.

Instruction from the full-time faculty is too theoretical or abstract.

Most of what I have learned so far in this residency has been from paramedical personnel.

Residents' Work Week

For seven days each resident kept a daily log of his activities in each of seventeen categories (of which the 11 most prominent are included here). These data were then combined to describe an average work week for residents in each of the four residency years. The findings are summarized in table 9.

The most striking item is the length of the average working day, 11 to 12 hours, seven days a week over a four-year period. With such a pattern established during training, the continued stamina and drive which seem to characterize the orthopaedic community should come as no surprise. Whether such intensity provides an optimal experience for learning other attitudes and values, as well as the problem-solving skills and reflective thinking which represent residency program goals, is in question. However, as the third category of resident attitudes indicates, residents are equally divided regarding complaints about the amount of time spent in night duty, obtaining equipment and services, etc.

The essentials of an approved residency of the American Board of Orthopaedic Surgery, like the essentials of an approved internship, state unequivocally that these training experiences must first be designed for learning. In the course of this learning, medical services must be rendered, but service is relatively a secondary, rather than a primary, outcome. While there may be differences of view about the extent to which on-the-job training is primarily educational, there would probably be fewer disagreements with the principle that effective learning requires some designed sequence, and that learning critical judgment in patient management demands graded and ever-increasing responsibility. The 11 time components reported in table II-9 (p. 52) are divided into three elements arbitrarily labelled formal learning (observing surgery, assisting surgery, attending learning activities, professional reading, and research), executing (which also embraces learning by doing through in-patient care, out-patient care, emergency room care, performing surgery, and clerical work), and teaching. The resulting categorical time commitments are summarized in table II-10. While there is a tendency toward decrease in formal learning activities and increase in execution and teaching over the

four years, which may suggest some sequence and graded responsibility, none of these differences is statistically significant and certainly do not appear great enough to have educational significance. Perhaps most surprising is the observation that research, which many would feel represents a culminating experience that is more likely to be fruitful if based upon a steadily widening familiarity with significant problems, appears to occupy far more time in the first residency year than in the final year. However, since some programs completely devote the first year of residency to resident research, the average amount of research done by first-year residents may be inflated by inclusion of these programs.

TABLE II - 9

Mean Hours per Week Residents Spent in Selected Activities

	1st Year		2nd Year		3rd Year		4th Year	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I. In-patient care	17.0	7.45	17.8	6.45	15.3	5.52	15.7	5.23
II. Out-patient care	9.3	5.21	11.7	5.74	10.3	5.75	11.7	5.80
III. Emergency room	6.5	6.25	7.1	5.51	7.4	6.54	5.6	6.00
IV. Observe surgery	1.1	2.01	1.1	1.52	1.0	1.39	1.3	1.90
V. Assist surgery	9.0	4.92	7.5	4.17	7.5	4.35	6.3	4.07
VI. Perform surgery	4.4	3.76	5.9	3.52	6.8	3.94	7.5	4.51
VII. Teaching	3.3	3.27	4.7	3.24	7.6	4.52	8.7	4.95
VIII. Attend scheduled learning activities	6.5	3.10	7.6	3.47	6.8	3.46	7.5	3.52
IX. Professional reading	9.0	3.17	10.4	4.20	8.6	2.79	8.3	2.98
X. Research	6.3	5.43	2.9	3.80	2.9	3.40	2.4	2.82
XI. Clerical work	4.9	2.83	5.4	2.06	5.5	2.62	5.7	3.06

TABLE II - 10

Weekly Hours per Category

	1st Year	2nd Year	3rd Year	4th Year
Learning	31.9	29.5	27.6	27.8
Executing	42.1	47.9	45.3	46.2
Teaching	3.3	4.7	7.6	8.7

Operative Procedures

On the average, a resident spends 14.9 hours per week, 775 hours per year, or approximately 3,000 hours during his residency in the operating room either observing, assisting, or performing surgery. We now turn our attention to when residents learned, from whom they learned, and how confident they are about what they learned in this time.

The residents are from quite varied training programs which have their own characteristics in terms of patient population, selection of cases for resident teaching and training, and precedence with regard to delegation of resident responsibility and authority. (See the next section for a discussion of delegation of authority.) However, clear patterns emerged which can describe most resident experiences with certain operative and nonoperative procedures.

Residents responded to five questions about each procedure by checking one of the alternatives provided.* The questions were:

1. When did you first learn this procedure?

2. How many times have you performed it?

3. How well can you perform it?

4. Who first taught you?

5. If self-taught, what method(s) did you use?

A total of 58 procedures were selected to represent varying degrees of difficulty and did not attempt to be representative of procedures that all orthopaedists should know.

It is interesting to note that residents at different levels of training respond differently when asked <u>when</u> they learned a particular procedure. The percentage of residents who report having learned a procedure before beginning

---

*See Resident Procedures Form, Supplement.

residency is usually highest for first-year residents, with a steady decline in this percentage for second-, third-, or fourth-year residents. This finding would support the hypothesis that what the resident accepts as evidence of learning changes as he progresses through his residency training; he may discover during residency that he really did not know all of the implications and possible complications of a particular procedure as well as he thought he did. This decline in perceived early competence is common for many of the procedures surveyed.

Previous Experience

There were 15 procedures that over 75 percent of the residents stated they learned before entering orthopaedic residency. These procedures consist primarily of two types of experiences. First, those procedures commonly delegated to students, interns, or first-year residents (e.g., injecting a painful joint). Although there can be a good deal of discussion about how well they are accomplished, the tasks are generally considered to be relatively simple and have a wide margin of safety, and any errors which occur can be modified fairly easily when seen later by a more experienced person. The second types of experience are those procedures which are ordinarily emergent in nature, and, perhaps more important, frequently quite urgent. A resident confronted with a patient requiring a tracheostomy and/or in shock, quite simply does not have time to seek consultation. He must undertake the immediate treatment and management until a more experienced person arrives. Such emergent procedures may have been learned earlier in the military or in the emergency room.

Orthopaedic Training

There were 34 procedures that fewer than one-fourth of the first-year residents reported they knew how to perform prior to their orthopaedic residency. A large number of these are more involved orthopaedic procedures that are less likely to have been delegated to the student or intern(e.g., perform

a wrist synovectomy, repair a lacerated digital nerve, and insert a medullary rod in the femur). Others are considered more esoteric in contemporary orthopaedic surgery, regardless of the level of experience, (perform a needle biopsy of a lumbar vertebrae, insert Harrington rods, perform and interpret an arthrogram). Some others are procedures in which the risk of the situation is such that the attending staff feels compelled, or are required by contemporary society, to undertake themselves (e.g., manipulate a contracted joint, perform an innominate osteotomy, give expert testimony in a court of law).

No Experience

More than 10 percent of fourth-year residents reported that they never learned eight of the procedures, more than 25 percent never learned five of the procedures, and more than 50 percent never learned six of the procedures. The failure of fourth-year residents to learn these procedures may be attributed to several of the following causes or a combination thereof. These procedures are not common in any orthopaedic service (e.g., apply a minerva jacket, apply a corrective cast for scoliosis, perform an innominate osteotomy). Others are simply not done in some areas of the country or by some orthopaedic services because of local precedence (e.g., insert Harrington rods, perform a laminectomy and discectomy, perform and interpret an arthrogram). A few of these are procedures frequently done by a consulting service or a consulting surgeon (e.g., repair a lacerated blood vessel, perform and interpret a nerve conduction test, perform and interpret an EMG). Finally, there are those procedures which ordinarily are not delegated because they are medical-legal situations in which attorneys and compensation boards prefer to have already certified individuals with all credentials necessary to impress an arbitrator or a jury (e.g., give a legal deposition, or expert testimony).

If learning any of the procedures in this section is critical to the complete training of an orthopaedist, then some organized method of assessing resident's exposure to learning the procedures should be devised. Many programs require residents to keep a list of the operative procedures which they performed or assisted at. The list is reviewed

periodically with the chief or one of the attendings to assure complete exposure to and learning of important procedures.

The list of procedures which many fourth-year residents have not learned, has already been employed by a few programs to assure the resident's exposure to the following: giving a legal deposition, giving expert testimony in a court of law, and evaluating a disability and reporting those findings in a form acceptable to a compensation board. Attendings from these programs realized that while these three procedures were ones that they perform very frequently in private practice, the residents-in-training in hospital settings have no experience with them. One program designed a rotation in medical-legal problems during which a resident would write and evaluate disability reports, hear court testimony, and help prepare legal depositions given by the attending staff.

What would possibly be considered more important by many practicing orthopaedic surgeons is the fact that there are residents completing formal training who have not done a laminectomy and discectomy, have not performed and interpreted a myelogram, did not feel confident in their ability to repair lacerated blood vessels, or have not performed or been exposed to anterior cervical fusion. This, however, is a reflection of contemporary practice and in the course of designing programs one must constantly keep abreast of what constitutes contemporary practice so that the graduating resident is not only well-prepared to meet the demands and challenges ordinarily placed upon him early in his practice but is also exposed to procedures that may be in the developmental stage when he is in training but may become far more common after he has been in practice five to ten years.

Confidence without Performance

A number of residents reported confidence in their ability to perform without actually having done a procedure. This discrepancy between not having performed the procedure and having confidence in the ability to perform it seems more apparent than real. One has to realize that the practicing orthopaedic surgeon is constantly expected to be able to perform procedures or certain applications

of those procedures that he has never performed before. This implies that emphasis on basic surgical principles and basic knowledge is extremely important during residency, since it would not be reasonable or possible for a resident to be exposed to all the possible procedures he may be required to do.

Summary

This Study indicated a wide variety of resident training among the orthopaedic residency programs surveyed. This variety of experience with the 58 selected procedures exists for both residents beginning their training and those about to enter practice. There were orthopaedic procedures which over 75 percent of the residents beginning their orthopaedic residency had previously learned. There were some orthopaedic procedures that over 55 percent of the residents about to complete their final year had not learned. There were also orthopaedic procedures which residents had never performed but had confidence in their ability to perform when called on to do so.

The significance of these findings is in the example it provides for the method of gathering detailed information during residency programs about what residents are learning. It may provide a model upon which a core curriculum of basic procedures all qualified orthopaedic practitioners must be able to perform with confidence can be derived and evaluated. It may provide program chiefs with a means of evaluating the clinical variety available to each of their residents. Also, it may form the means of discovering continuing education needs. The format of the instrument can provide information necessary for all the above purposes.

Responsibility in Operative Procedures

Individual operative procedures were examined in the previous section. The detailed steps in decision-making about the performance of general operative procedures is the subject of this section.

Residents were first asked to define in their own words the two most common types of patients in the hospital of their present rotation. They mentioned three categories most often. They are, in the words of the resident, private, clinic, and third-party-payment patients.

Although residents were directed to respond to the questions personally, it appears that they responded as residents in general, since responses of residents at all levels of traininig were essentially the same.

Preoperative management of patients is most often controlled by residents with all types of patients. Residents have this responsibility most often for clinic patients (83%) and least often for private patients (48%).

Arranging for proper equipment in the OR is usually handled by the resident in 70 percent of the cases, by the OR staff in 20 percent of the cases, and by the attending in a little over 10 percent of the cases.

The attending's role at the operation is quite different depending upon the type of patient (see table 11). The attending performs about half of the operations for the clinic and third-party-payment patients, observes one-quarter of them, and is not present in the OR but available in the immediate area for the remaining one-quarter.

The entire operation is usually done by the attending, or by the resident with step-by-step guidance from the attending, for 62 percent of the private patients and 16 percent of the clinic patients. With comments, assistance, or observation by the attending, the resident performs the operation for 27 percent of the private patients and twice that for the clinic and third-party-payment patients.

Ancillary procedures as a part of a larger procedure, such as obtaining grafts, are most commonly done by the

resident (80%). The resident is in complete charge while the attending may not be present in about half of the cases for clinic and third-party-payment patients, and in one-quarter of the cases for private patients the attending may not be physically present in the OR.

Closure of the wound is done by the resident in 90 percent of all cases and the resident is in complete charge in over half of all cases with the attending making comments in less than 20 percent of all cases and in the remaining 20 percent the attending gives step-by-step guidance.

According to the residents who responded to this survey, in over three-quarters of all cases the following are discussed with the attendings:

1. nature of actual or potential complications
2. management of actual or potential complications
3. rehabilitation of the patient
4. prognosis of the patient

Between 65 and 75 percent of the time, the following are discussed:

1. steps in the basic operative procedure employed
2. pathology of the case
3. degree of success of the case

When not specifically discussed with the attending, the residents either had these matters enumerated by the attending or they discussed them with other residents. In about 10 percent of the cases these matters were not discussed.

The least discussed item among those listed was the basic principles of instruments and equipment employed. In 60 percent of the cases it was discussed by attendings or resident groups and in 30 percent it was not discussed at all.

TABLE II - 11

At the Operation the Attending Usually:

	Private (%) N=138	Third Party (%) N=123	Clinic (%) N=46
Performs or assists the resident	80	50	39
Observes the operation	7	26	25
Is not in the OR but in the area	6	24	30

The Attending Staff

Composition and Functions

The attending staff is likely to number at least five and not more than 20 attendings, the average being twelve. Typically, at least 10 of the 12 attendings derive all income from private practice and devote no more than 25 percent of their time to resident education. Fewer than half of the programs report one or more full-time attending staff members whose total incomes are derived from salary. Typically, such a staff member devotes not more than one-third of his time to formal teaching activities, the balance being allocated to clinical, administrative, and research duties. He differs from his part-time colleagues in that he is more likely to function in all four areas, whereas at least a quarter of the part-time staff have neither administrative nor research responsibilities.

For both the full-time and part-time attending staff, the activites related to resident education most commonly include ward rounds, and clinic or operating room supervision. Almost as many attendings spend at least some time in individual conferences with residents, and approximately two-thirds report at least some participation in grand rounds and special lectures.

Tables 12 and 13 indicate that attending staff, like teachers in other areas of education, support contemporary theories of administration, planning and teaching, based on educational psychology principles.

Values and Attitudes

With respect to the goals of residency training, most attending staff feel that residents should be evaluated on attitudes as well as on achievement and that attitudes can be modified during residency. They are divided on the question of the desirability of resident research, and most disagree (some strongly) that the development of surgical skill is "the most important function of the residency."

While attendings tend to agree that staff should use a resident's previous experience in deciding what he should do on his new rotation, over half disagree (some strongly) that the goals of the residency should be determined by the resident's needs and interests, and one-fourth disagree that individual differences should be accommodated in planning the overall program of each resident. While they also tend to agree that "mature residents learn more on their own initiative than under tight supervision," they are almost divided on the question of whether "residents should have more supervision than they get," whether they will "cover important material without some prodding " and whether, if given a free choice of activities, "residents generally select what is best for them." Finally, substantial numbers disagree (some strongly) that "residents should be given more freedom in designing their own programs," and about three-quarters agree (some strongly) that "discipline is necessary for maintaining resident productivity." Although most of them express the view that "effective teaching is enhanced by getting to know the residents well," at least half of the attending staff feel that they are most effective when they maintain a "proper professional distance" between themselves and residents; at least one-fourth believe that an attending staff member who becomes involved in the personal problems of residents loses his effectiveness as a teacher.

In summary, the results show that attendings are quite different in their perceptions about methods of learning and strategies for organizing and administering an orthopaedic residency program. The disparity is typical of educators in general and indicates a need for discussion among the attendings in each program about the principals of learning and instruction to be used in their program. The staff development procedures discussed elsewhere in this report provides a media for such discussion in an organized series of topic areas.

TABLE II - 12

More than 85 Percent of the Attendings Responding to the Attending Attitude Survey Agreed with the following Statments:

1. The most effective teacher has a personal interest in the progress of each resident.

2. Skillfull teaching can increase a resident's interest in orthopaedics.

3. The residents' service responsibilities are useful for learning orthopaedics.

4. Residents learn research procedure best by doing research.

5. Attendings should make allowance for individual difference when teaching residents.

6. Attendings who respect residents encourage participation in planning patient management

7. Good teaching cases relate isolated problems with overall goals of orthopaedic management.

8. The contrasting skills and interests of residents makes team work a profitable experience.

9. Attendings should have an overall plan of program objectives to use in their work with residents.

10. Resident morale is maintained when open communication is possible.

11. Demonstrated interest in a resident's progress increases his productivity.

12. Follow-up is as important a learning experience for residents as is acute management.

13. Teaching residents is a valuable activity.

TABLE II - 12 (Cont'd)

14. Residents should be evaluated on attitudes as well as on achievement.

15. Attendings should be prepared to demonstrate the relationship between basic information and clinical problems.

16. Residents learn best in an atmosphere of mutual respect.

17. Discipline is necessary for maintaining resident productivity.

18. A good residency program integrates the basic sciences with clinical problems.

19. Attendings should participate in the teaching program if they wish to have residents working on their service.

20. Patient management experience aids residents in the development of suitable attitudes toward patients.

21. Residents learn most efficiently by being required to assume responsibility for patient care.

TABLE II - 13

More than 70 Percent of the Attendings Responding to the Attending Attitude Survey Disagreed with the following statements:

1. Teaching on ward rounds is usually impractical.
2. Teaching residents is best done by giving organized lectures.
3. The quality of the teaching program has no effect on the residents' interest in orthopaedics.
4. Attendings adequately meet their teaching responsibilities just by providing patients.
5. The major function of the resident is to assist in getting the work done.
6. All an attending needs, to be a good teacher, is an extensive knowledge of orthopaedics.
7. The residents' service responsibilities interfere with their learning.
8. Developing surgical skill is the most important function of a residency program.

III - ANALYTIC STUDIES

Data Definition

There are two examinations mentioned often in the following sections of the report. To prevent duplication they will be explained once here.

The Orthopaedic In-Training Examination (OITE) is administered yearly to residents in orthopaedic residency training programs. The examination consists of multiple choice questions (M/C) and written simulations of clinical encounters with patients, also called by two other descriptive terms (patient management problems (PMP) and erasure examination). Erasure examination is a term used commonly by the resident examinees and is descriptive of the format of the questions. Information gathering and decision making involved in solving the problems are done by erasing areas on the examination booklet, thus obtaining information needed to proceed through the examination. The examination results are reported as follows:

Multiple choice questions

total score	
general orthopaedics	)
adult orthopaedics	) - A
children's orthopaedics	)
trauma	)
anatomy	)
physiology-biochemistry	)
pathology	) - B
biomechanics	)
hand	)
rehabilitation	)
recall	)
interpretation	) - C
problem-solving	)

Patient management problems

total score	
diagnosis	
treatment	
recall	)
interpretation	) - D
problem-solving	)

In A, each multiple choice question is categorized into one of the subject matter areas listed. In B , M/C questions are categorized on other content and a question may appear in more than one category. The definition of the scores in C and D is as follows:

recall - items which may be answered on the basis of remembered factual information.

interpretation - items which may be answered by proper interpretation of verbal or visually -presented findings.

problem-solving - items requiring clinical judgment or employment of problem-solving strategies in addition to factual information and interpretive skills to answer.

The two PMP scores are defined as follows:

diagnosis - the culmination of history, physical examination, laboratory, x-ray diagnosis, and consulatation in which the examinee is invited to select as many as he would like in the diagnosis of patient disorders

treatment - the culmulative decisions implementing treatment of patients

The above definitions are taken from reports of the American Academy of Orthopaedic Surgery.

The second examination mentioned in this research is the Orthopaedic Certification Examination (OCE). This examination consists of the same types of questions and scores as the OITE in addition to a number of oral examinations which are not discussed in this research.

Prior to the administration of the OITE, the chiefs of residency training programs were requested to provide information about resident's achievement in selected areas. This Resident Evaluation Form consisted of 12 scales. For each scale, the chiefs were requested to compare each resident to the average of all residents at that level of

training that he has known. The scales range from 1 to 12 with 6.0 called average. (See Supplement for sample).

Interpretation of Correlations

A correlation is an index of association between two variables or measures. When evaluating "the worth" of any correlation coefficient, there are two matters to consider. The first is the significance level of the statistic. In order to put any faith in the predictive usefulness of a correlation coefficient it must be large enough to be statistically significant. A statistically significance correlation is one in which there is a high probability that the observed association is not due to chance. Statements such as $p < .05$ and $p < .01$ indicate that the probability of the correlation coefficient being due to a chance association between the two variables is less than 5 in 100 and 1 in 100 respectively.

The second matter to be considered is the educational significance or usefullness of the calculated correlation coefficient. Educational significance is a matter of how well the coefficient can serve as a predictor of performance. A coefficient less than .2 indicates only a slight relationship between the two variables and is of little use as a predictor. In the research under consideration here are studies of characteristics of residency programs and residents, related to performance scores on the OITE. In many cases statistically significant correlations below .2 were found. Such findings indicate a slight relationship between the characteristic and performance but certainly do not indicate that these characteristics taken individually are useful for prediction of performance. Finally, it should be noted that although variables that have a cause-and-effect relationship to each other certainly will be expected to be correlated, the fact that two variables are correlated can never be used as evidence that a cause-and-effect relationship exists. Correlation only indicates an association between two variables.

Sample vs Population

In Phase II of the Orthopaedic Training Study, two samples of residency training programs were selected from all U.S. programs. The first consisted of 280 residents from 16 residency training programs from which extensive data collection and site-visits to observe the program in action were to be made. This group of programs was titled the intensive study sample. The second consisted of 504 residents from 35 programs and was titled the survey study sample since the residents from this group of programs were only to complete several questionnaires. Together these samples are called the Study sample comprising 784 residents from 51 residency training programs. (See supplement).

In order to determine if achievement of the Study sample could be said to be representative of the population of all U.S. programs from which this sample was drawn, a study was conducted which compared the yearly Orthopaedic In-Training Examination (OITE) scores of the Study sample with those of the population.

Statistically, this procedure entailed constructing a confidence interval about the population mean using the standard error of measurement of the mean, a function of the standard deviation of the population, and the sample size.

As Table 1 indicates, the study sample is significantly different from the population for nine of the 11 scores of the OITE. The two non-significant scores were within .2 of being significant. Therefore, the study sample cannot be considered a random sample form the population but must rather be considered to be comprised of residents above average in the orthopaedic knowledge and abilities measured by the OITE. Since the OITE, along with ratings of residents by their chiefs of training were to be used as a criterion of achievement success in the residency training program, this result has great importance. Care must be taken when generalizing test score characteristics of individuals in the Study sample to the population. However, the standard deviations of the Study sample and the population were nearly equal, and comparisons of characteristics of individual residents variation from other residents at any

point above or below the sample mean represents much the same range of differences as is represented in the population. Correlations, or comparisons of high scoring and low scoring groups from the Study sample can therefore be generalized to the population.

TABLE III - 1

Population-Study Sample Comparison

Score	Lower Limit	Population Mean	Upper Limit	Study Sample Mean
Total multiple choice (m/c)	127.4	129.4	131.4	134.5**
M/C general orthopaedics	29.9	30.5	31.1	31.6**
M/C adult orthopaedics	46.9	47.6	48.3	49.1**
M/C childrens orthopaedics	36.6	37.4	38.2	38.6**
M/C trauma	13.6	13.9	14.2	14.1
M/C recall	104.0	105.7	107.4	109.3**
M/C interpretation	15.5	15.9	16.3	16.4**
M/C problem-solving	7.7	7.9	8.1	8.0**
Patient management problem total	85.0	86.9	88.8	90.0**
PMP diagnostic	29.2	29.9	30.6	30.7**
PMP treatment	55.4	57.0	58.6	58.5

** $p < .01$

Yearly Consistency of Chiefs' Rating Form

This study was conducted to compare various ratings given residents each year by their chiefs of training in conjunction with the Orthopaedic In-Training Examination program. The hypothesis was that the correlations between yearly ratings given residents would decrease as the time between the ratings increases, (i.e. all residents would not increase in their abilities equally as they progressed through the residency).

As Table 3 indicates, the mean rating for all factors increased from year one to year four by about one point per year, from 6.0 to 8.8, on a 12 point scale. The chiefs were instructed to compare each resident to all residents at that level of training that he has known. Assuming that the chiefs followed the instructions exactly and that the present residents were about the same as previous residents in the achievements rated, the average ratings at each year in training should be the average rating of 6.0 on the 12 point scale. It appears that the present first-year resident is about average (6.0 of a possible 12) considering all the first-year residents that the chief has known; but his second-year residents are about eight percent better than all second-year residents he has known (i.e. 7.0 of 12 or 58 percent, 8 percent better than average), the third-year residents are about 17 percent better and his fourth-year residents are rated as about 25 percent better than all the fourth-year residents he has known. Another possible explanation is that the chiefs are rating each resident as compared to first year residents In this case, first-year residents are average and residents improve about 8 percent per year.

When we turn our attention to the hypothesis under question, we find that for three of the five factors the hypothesis is supported. (see Table 2). The exceptions were the factors of overall competence as an orthopaedic surgeon and the knowledge of basic science as related to orthopaedics which are significantly correlated in both comparison year pairings. The significant correlation of these two factors in rating the same residents over time indicates

that, as rated by their chiefs, residents gain similar amounts in their basic science knowledge and overall competence. For the chiefs' ratings of knowledge of clinical orthopaedics, ability to use information to solve problems, and judgment in deciding appropriate care and treatment, although the average rating increased by about one point from year to year, the correlations between the ratings decreased as the time between the ratings increased. Also, for these three factors, the first-second year correlations are statistically significant, while the first-third year correlations are not statistically significant. It is assumed that the same chiefs made the ratings for each resident at each year.

The fact that correlations between rating of these factors decreased over time indicates that, as perceived by the chiefs, all residents do not increase in their achievement by the same amount. If all residents were to increase their achievement the same amount each year, the correlation between yearly ratings would be very high. It appears, therefore, that the chiefs of training are aware of changes of different degrees in the individual residents that they rate and that they do not merely consider that a year of experience has the same effect on all of his residents.

TABLE III - 2

Correlations of Chiefs' Ratings of Residents
at the First, Second and Third Years of Training[a]

Chiefs' Rating of:	Year 1 vs. Year 2 N = 100	Year 1 vs. Year 3 N = 48
Knowledge of clinical orthopaedics	.36***	.33
Knowledge of basic science as related to orthopaedics	.41***	.42**
Ability to use information to solve problems	.23**	.10
Judgment in deciding appropriate care and treatment	.40***	.26
Overall competence as an orthopaedic surgeon	.39***	.34**

**p < .01
***p < .001
a - too few first vs. fourth-year ratings were available for useful correlations

TABLE III - 3

Mean Chiefs' Ratings for Each Year in Training

Chiefs' Rating of:	Year in Training			
	1	2	3	4
Knowledge of clinical orthopaedics	5.7	6.7	7.9	8.8
Knowledge of basic science as related to orthopaedics	5.9	6.7	7.5	8.2
Ability to use information to solve problems	6.5	6.9	7.6	8.9
Judgment in deciding appropriate care and treatment	6.3	7.0	7.7	8.8
Overall competence as an orthopaedic surgeon	6.0	6.9	7.8	8.9

Correlation of Chief's Ratings and OITE Scores

This study was conducted to determine the relationship between selected chief's ratings and scores on the OITE. It is generally thought that correlations between subjective measures, like the chief's ratings, and objective test scores will be low because of the expected unreliability of subjective ratings (i.e., differences in the criterion employed by various raters), especially with the ratings made by 51 chiefs. If scores on the OITE are accurate measures of certain achievements of residents and if inter-rater reliability is high, correlations with the chief's rating of similar achievements would be expected.* It was hypothesized that there would be significant correlations between the following rating factors and examination scores:

Rating Factors	Scores
Knowledge of orthopaedics, clinical and basic science	Multiple choice total score
Problem solving ability	PMP diagnosis
Judgment in deciding on treatment	PMP treatment
Overall competence	PMP total score
Overall competence	Multiple choice total score

The results were analyzed for residents at each level of training. There were 152 first-year residents, 393 second-year residents, 441 third-year residents, and 382 fourth-year residents in the study.

The results indicate that the total multiple choice score was significantly correlated with all of the selected chief's ratings of residents at each of the four levels of training. These correlations ranged from .42 to .20. The

*See table 4 (III), p. 81.

patient management problem (PMP) total score was significantly correlated with all selected chief's ratings for second and third-year residents only. These correlations were lower and ranged from .20 to .13.

Of the particular scores expected to correlated highly with the chief's ratings of similar achievements, five of the six were significantly correlated (see Table 4). As expected, significant correlations were found at all four levels of training between the knowledge of clinical orthopaedics, knowledge of basic science as related to orthopaedics, the overall competence as an orthopaedic surgeon ratings and the total multiple choice score. For three of the four years in training significant correlations were found between the judgment in deciding appropriate care and treatment rating and the treatment PMP score. Also, for three of the four years in training significant correlations were found between the overall competence rating and the PMP total score.

In general, the OITE scores which summarize the residents' performance on each of the two sections of the exam, multiple choice total score and PMP total score were the best predictors of all the chiefs ratings. Knowledge of basic science as related to orthopaedics, knowledge of clinical orthopaedics, and the overall competence ratings, in that order, are most associated with the multiple choice scores. Since the multiple choice questions on the OITE are composed of orthopaedic basic science and clinical application questions, many of which call for recall of information, it is logical that the chief's ratings of knowledge in these areas were most highly correlated with the multiple choice score. Since many of the multiple choice questions, besides requiring knowledge of facts, were designed to tap areas involving the interpretation of, judgment with, and application of facts, it was expected that the total multiple choice score would be significantly correlated with the chiefs rating of overall competence as an orthopaedic surgeon.

Knowledge of clinical orthopaedics and overall competence as an orthopaedic surgeon, in that order, were most associated with the PMP total score. Since the PMP was composed of similated clinical encounters, it was not surprising that the chief's rating of knowledge of clinical orthopaedics had the highest correlations with the PMP total score. Similarly, there was the expected significant correlations between the PMP treatment score and the chief's rating of judgment in deciding appropriate care and treatment of patients. Clinical judgment involves the ability to decide upon and carry out a treatment plan and it is this ability that the PMP treatment score purports to measure. This evidence indicates that it deals with similar concepts. The expected relationship between the rating of the residents ability to use information to solve problems and the PMP diagnostic score was not apparent. This correlation was very low for three of the four levels of training. This apparent discrepancy can possibly be explained by the manner in which the diagnosis section of the PMP on the OITE is scored. It is not scored on the basis of merely obtaining the correct diagnosis but rather on the basis of thoroughness of the inquiry. This distinction is evidenced by the fact that practioners score lower than residents on the diagnosis section only. Therefore, the diagnosis PMP score is perhaps more an evaluation of thoroughness of diagnosis and should not be expected to correlate highly with the chiefs rating of ability to use information to solve problems.

A comparison of the scores and ratings of similar achievements indicated the expected significant relationship. These results provide evidence for two conclusions. First, there is some evidence of chiefs' consistency in rating resident's achievement. If there were great inter-rater variety in the criterion used by the 51 chiefs in making the ratings, the ratings would not correlate with any other measures of similar achievement. Second, there is evidence that the OITE scores have some validity (i.e., they measure what they are intended to measure). Consistent with expectations, correlations were found between ratings

and scores of similar achievements. This finding provides partial evidence of the concurrent validity (or correlation with other independent measures of the same ability) of these scores. In general, it can at least be said that chief's ratings and OITE scores are both evaluations of similar kinds of achievement.

TABLE III - 4

Selected Correlations between Chiefs' Ratings and OITE Scores for each Year in Training

Factors - Test Score	Year in Training			
	1	2	3	4
Knowledge of clinical orthopaedics rating and total multiple choice score	.26***	.36***	.39***	.28***
Knowledge of basic science as related to orthopaedics rating and total multiple choice score	.30***	.42***	.40***	.35***
Ability to use information to solve problems rating and diagnostic PMP score	.03	.15***	.03	.02
Judgment in deciding appropriate care and treatment rating and treatment PMP score	.18**	.09	.14**	.15**
Overall competence as an orthopaedic surgeon rating and PMP total score	.14*	.16***	.14**	.10
Overall competence as an orthopaedic surgeon rating and total multiple choice score	.23**	.26***	.27***	.22***

* $p < .05$
** $p < .01$
*** $p < .001$

Characteristics of Residency Programs and Residents Correlated with Residents Examination Scores

1. Orthopaedic Training Program Characteristics Related to Resident's Performance on the OITE.

In order to determine which characteristics of orthopaedic programs are associated with resident performance on the OITE, a correlation study was conducted. Only fourth-year residents from the Study sample were employed in the analysis, since effects of the program characteristics would tend to be more apparent in their performance than in that of residents at other levels of training. There were 428 fourth-year residents included in the study.

There was a significant correlation between the multiple choice total score on the OITE and each of the program characteristics listed. These correlations ranged from .20 to .13. Higher multiple choice scores were associated with residents from programs with the following characteristics:

Chief

1. the chief's major office was in or very near the principal institution of the program
2. the chief had much of his total income from salary
3. the chiefs of service held academic rank

Resident Selection

4. resident selection was done primarily on the basis of a candidates academic standing in medical school, his intellectual approach to problems, and his recognized interest in research
5. resident selection was not primarily done on the basis of technical aptitude or emotional maturity

6. applicants for residency who were vulnerable for malitary induction during the residency were acceptable

7. preference was given to graduates of the affiliated medical school (if there was one)

Objectives

8. the primary objective of the program was the production of the community practice oriented orthopaedists
9. the primary objective was not the production of orthopaedic subspecialists or academicians

Residents

10. there were many residents in the program
11. residents instructed medical students
12. residents were required to write a clinical or laboratory research paper
13. after completing the program residents did not stay on in supervisory positions
14. some, but not many, residents have failed to complete the program in the last five years
15. residents who failed to complete the program were judged unacceptable because of poor clinical judgment
16. during the first two years of residency, residents salary was below $7500 per year
17. there was supervision provided the resident in the operating room according to the needs of the individual resident rather than supervision in all cases
18. there was a fellowship staff

Program Facilities

19. clinical material was more often adult and pediatric, as opposed to trauma
20. a biomechanics subspecialist was on the orthopaedics staff

21. a neurologic disorders subspecialist was on the orthopaedics staff
22. there was a veterans' hospital associated with the program

The converse of each of the program characteristics is associated with lower multiple choice total scores, for example:

1. Chief's major office was not near the principal institution of the program

4-5. resident selection was not done primarily on the basis of academic standing in medical school, etc. but was done primarily on the basis of technical aptitude and emotional maturity
10. there were few residents in the program
19. clinical material was more often trauma than adult and pediatric

Characteristics not mentioned such as the number of attendings who teach residents, kinds of clinics available, the use of a follow-up clinic etc. were not significantly related to resident's OITE scores.

2. Resident background related to OITE scores

This study was conducted to determine relationships between the background of orthopaedic residents and their performance on examinations. There were 299 fourth-year residents included in the study. Significant correlations ranged from .19 to .15. Residents with the following characteristics tended to have high multiple choice OITE scores:

1. younger than average
2. decided on orthopaedics as a specialty at an early age

3. had a high grade point average in high school, college, and medical school
4. had a high rank in class in high school and college, and medical school
5. liked mathematics in both high school and college
6. selected their orthopaedic program because of its reputation and not because of any offer of financial support
7. was satisfied with the general reputation of the training program
8. was dissatisfied with the opportunities for surgical experience to date
9. was dissatisfied with the amount of responsibility they are given in the treatment of patients and wish they had more responsibility
10. marital problems were not an interference with work in the residency program

On the other hand, low scoring residents can be said to tend in the opposite directions on all of the characteristics listed above. For example, the residents who scored low on the multiple choice section of the OITE tended to be older, had a lower grade point average and rank in class, were not satisfied with the general reputation of the program, and marital problems interfered with their work in the residency program.

Characteristics not mentioned, such as size of home town, parental occupation, or amount of family income, size of high school, college, or medical school, type of internship, etc. and others listed on the background questionnaire (see supplement) were not significantly related to multiple choice scores.

3. Resident attitudes related to OITE scores

The significant correlations between fourth-year residents' attitudes and the multiple choice total score were few and negative. A negative correlation indicates that agreement with the attitude statement is related to low multiple choice score and disagreement is related to high multiple choice scores. There were 265 fourth-year residents in this study.

TABLE III - 5

Significant Correlations between Resident Attitude Statements and OITE Score

Attitude Statement	Correlations with multiple choice scores
1. There are too many ward (charity, indigent) patients admitted on my service	-.21***
2. There are not enough private patients on my service	-.17**
3. There is not enough elective time provided	-.17**
4. Teaching takes too much time away from more important things I want to do	-.17**
5. There are so many demands on a resident that they are almost impossible to meet	-.16**
6. I have sufficient opportunity to use my operative skills	-.20**

**p < .01
***p < .001

The negative correlation of multiple choice scores with the first five statements in Table 5 indicate that low scores were associated with residents who complain about types of patients on their service (items 1 and 2) and about the large number of demands upon them with too little time to fulfill them (items 3, 4, and 5).

Low multiple choice scores were also associated with resident's satisfaction with their opportunity to use their operative skills (item 6). Conversely, high scoring residents were likely to state that they have not had such opportunity. Supplementary data was found in the background questionnaire. When asked to evaluate certain aspects of their residency, high scoring residents again tended to be dissatisfied with the opportunities they have had for surgical experience, while low scoring residents were satisfied.

Interpretation of Results

In the results reported, the correlations ranged from .20 to .13, and were therefore all statistically significant. The educational significance of the results can be questioned since the correlations are low in terms of the ability to predict OITE scores by observing one of the characteristics reported in a particular program. It should be noted that the mere presence of any characteristic does not guarantee that residents will have high scores, and vice versa. Although statistically significant these correlations are low and indicate only a slight relationship between the characteristics and scores. It may also be that the high scores are associated not with the particular characteristics listed but with other characteristics associated with them. For example, a first and second-year resident salary of less than $7500 was associated with high scores. However such salaries are also associated with public institutions, as university programs usually are, which have been shown in past studies to be associated with higher scores.

The results surely indicate the multi-faceted nature of program effectiveness in the sense that there are many and varied individual characteristics of programs which were all related to program effectiveness. A further study of these program characteristics is described later in this report which employs many characteristics of the

program to determine if any combination of them provided a good basis for prediction of OITE scores. The value of the present study is that it indicates certain characteristics of programs that can be included in the prediction study.

Characteristics of Candidates for Early Board Certification

Among its objectives, the Orthopaedic Training Study was designed "to provide a model of individualized graduate education in medicine in which the demonstration of individual competence, rather than the fulfillment of rigid time requirements, mark the end of formal training." Under terms of the Study grant, residents from the intensive study sample of programs were given the opportunity to participate in the certification process of the American Board of Orthopaedic Surgery when they and their chief of training agreed that they were prepared to take the examination.

The purpose of this study was to determine if these abbreviated residency board candidates (ARBCs) differ from their fellow residents. Any differences found could be used to identify and select other potential ARBCs in residency with an attendant reduction in training periods. Such a process would increase the supply of orthopaedic manpower available in the health care delivery system.

In 1970 and 1971 a total of 23 residents from among the 331 residents in the 16 experimental programs exercised the option of taking the certification exam early. Of these ARBCs, nine were fourth-year residents and 14 were third-year residents at the time of the exam. No special provision for, or special designation of these men was made during the certification process. Examiners were only aware that ARBCs might be examined. All 23 attained scores considered by the American Board of Orthopaedic Surgery as satisfactory for certification.

Data from the background survey indicate that most of what has been said about the typical orthopaedic resident

(see resident background section) also applies to the ARBC group. However, the ARBCs were slightly younger, have fewer relatives who were physicians and fewer relatives in the health-related fields. They came from larger towns than their peers, their parents were slightly better educated, had higher incomes and more of them were self-employed than the parents of other residents in the Study sample. While fewer of the ARBCs considered occupations other than medicine, their choice of medicine as a career was made for similar reasons: desire for independence, interest in people, curiosity about the human body; but the ARBCs reported far greater interest in the profit, as a reason for entering medicine, than did other residents surveyed. A larger percentage of ARBCs received appointments in the residency program of their first choice but were more anxious about their appointments than other residents. ARBCs perceived far more competition in college than their peers and slightly more competition in medical school and in residency, although both groups report that residency was about as difficult as they anticipated. During the program, ARBCs differ from their peers in reporting less interference in training program atmosphere from relations with attendings; considerably more satisfaction with the academic enthusiasm of their program, and with the interest of residents with resident morale. They also reported slightly lower educational debts than did other residents; but they anticipated making five to 10 thousand dollars less per year after five years of practice. This estimation of income was possibly a realistic expectation in view of the fact that many of them report an interest in an academic career in medicine rather than straight private practice.

The OITE was conducted to provide multiple choice scores in many disciplines and taxonomy scores, and scores on patient management problems designed to simulate the encounter of the physician with the patient in a problem-solving situation. Results indicated that the ARBCs performance on all aspects of this exam was superior to their peers at each year in training.

TABLE III - 6

Average Percentile Rank of ARBCs Compared to Residents at the Same Year of Training on the Multiple Choice Section of the OITE

		As 1st Yr. Residents	As 2nd Yr. Residents	As 3rd Yr. Residents	As 4th Yr. Residents
1970 ARBC N = 9	Recall	(a)	(a)	90	83
	Interpretation	(a)	(a)	87	79
	Problem solving	(a)	(a)	68	71
	Total multiple choice	(a)	91	91	85
1971 ARBC N = 14	Recall	78	80	77	(a)
	Interpretation	89	65	65	(a)
	Problem solving	53	52	68	(a)
	Total multiple choice	83	78	73	(a)

a - Data was not reported

It should be noted that while ARBCs maintained their superiority over the average resident in each of the years, their percentile rank decreases as they progress through the residency. This indicates that the peers were catching up slowly, since they had more improvement to make. This phenomenon is also known statistically to occur often in multiple measurements of any group and is called regression towards the mean.

The 1970 ARBCs have higher percentile ranks than the 1971 ARBCs. This may be a result of the cautiousness and anxieties of the chiefs and residents in 1970, the first year residents have ever had the opportunity to take the OCE earlier than usual. The success of the 1970 ARBCs may have lowered the criterion, and certainly lowered the anxiety involved in the decision of chiefs and residents to participate in this experimental program in 1971.

The ARBCs continued to demonstrate their superior performance on the Orthopaedic Certification Exam (OCE). On the major test scores, total multiple choice and PMP total as well as all sub-test scores, the percentile rank of the ARBCs ranged from the 54th to the 74th with the majority above the 70th percentile. In general, it appeared that the ARBCs began their residency by demonstrating their superior ability on the OITE examination and this ability continued to be evidenced throughout the residency to and including the certification examination.

Prior to the annual OITE the chief of each training program submits a rating scale evaluating each resident in his program on overall competence and performance factors. After a consolidation of similar ratings, the comparison of these yearly ratings is presented in the table which follows.

TABLE III - 7

Average Chief's Evaluation of ARBCs and All other Residents in the Same Year in Training

	Year in Training					
	2nd		3rd		4th	
	ARBC	Peer*	ARBC	Peer	ARBC	Peer
Knowledge of Orthopaedics	8.1	6.4	8.4	7.7	8.4	8.6
Clinical ability	9.0	7.2	8.7	8.2	9.1	8.9
Surgical skill	8.5	6.5	8.4	8.2	9.4	8.9
Personal relationship	9.4	8.1	9.6	8.9	9.2	8.9
Long-term care	8.7	7.5	9.2	8.5	10.2	9.2
Emergency action	9.2	7.6	9.3	8.8	9.5	9.1
Moral and ethical responsibility	9.6	9.2	10.5	9.7	10.6	10.1
Overall competence	8.6	7.0	8.6	8.2	9.2	8.8

Note: Rating of 1 = Unacceptable, 12 = Outstanding performance

*Contains all residents at that level of training for which ratings were made

It appears that the chiefs of residency training programs have been sensitive even in the first year to the ARBCs superior performance. ARBCs are superior as rated by chiefs and in scores on the OITE.

ARBC Questionnaire

The final portion of this report is based on a personal survey questionnaire completed by each of the ARBCs concerning their career plans and preparation for the examination which was distributed after the certification exam was given. These data are being reported separately because they concern projections about future activities rather than present or past situations. Also, they are descriptive rather than comparative.

Of the 23 ARBC's 25 percent attended review courses prior to the OCE; of these, only one felt the course was not helpful. All ARBC's reported reviewing at least five years of the Bone and Joint Journal and reading two or more specialized texts in orthopaedics or related basic sciences. Only one man reported the OCE to be more difficult than expected and 25 percent indicated that it was somewhat easier than had been anticipated.

Despite the fact that the ARBCs were Board certified and not required by the Board to complete their residency, all but three chose to complete it. At the time of the survey, two of these indicated that they would enter private practice, and a third would utilize his remaining residency year in special fellowship training. The fact that most residents have a contractual obligation with a hospital did not seem to be an interfering factor in the decision making process reported by the residents. The primary reason reported by 20 of the 23 ARBCs for remaining in the residency is related to a feeling that training was still incomplete, a desire for special training, an obligation to the program, or the desire to complete the best rotation (usually chief resident).

Practice plans of the ARBC's are varied, with most (10) anticipating entering a single specialty practice group.

Since ARBCs had attached greater importance to the profit motive as a factor in their career choice, one would expect that anticipated practice income would be higher than other residents. Instead, their anticipated incomes are considerably less. This is, perhaps, a realistic expectation since 22 of the 23 ARBCs indicated a desire to do some teaching and four indicated a choice of full-time academics, which is probably not as monitarily rewarding as community practice.

It would appear that the major difference between ARBCs and their peers is, not in their general background, but their performance, both on examinations and in the medical care system. They have demonstrated superiority throughout their training period.

Such information, however, should not obscure the fact that 23 men were able to successfully complete the certification examination as much as two years earlier. This, coupled with the data reported, suggests three conclusions:

First, the results support the rationale behind the original objective of individualized instruction, i.e., apparently individuals learn at varying rates and, having established a criteria of competence, some can be expected to attain that level of required competence sooner than others, as indicated by the fact that they all passed the OCE.

The second conclusion is related, in that once competence rather than time remains the variable factor, significant manpower gains can be realized through early certification. It may also mean that the trend toward increased super-specialization may be accommodated without significantly increasing the length of time a man spends in training. The very talented may complete regular training early and move into super-specialty during the period which would otherwise be occupied by the basic program.

The fact that 20 of the 23 ARBCs chose to complete residency training, may not be as much of an argument against early certification (i.e., the man is going to stay around until he fulfills his training time anyway), as much

as an example of the need for planning and counseling residents. It also points out the need for some means by which potential ARBCs can be identified early in their training so that career plans, expectations, modifications and alternatives can be developed with these potential candidates. Such planning may well include discussions of the residents' services.

Third, apparently the chiefs of residency training programs have been sensitive to superior performance early in the residency, as indicated by the ratings on the resident evaluation form. When this is coupled with the fact that in all 23 cases the judgment of the chief and resident was vindicated, i.e., all 23 men who were thought to be capable of passing did so, considerable weight is given to the idea that the chief is an excellent judge of resident performance.

The Study suggests, also, that both the OITE and the Resident Evaluation Form appear to be consistent predictors of potential success and provide effective bench marks by which early candidates may be identified. Obviously, a great deal of additional study needs to be done to determine what other devices for prediction are available.

It seems rather clear from this study that carefully selected individuals, obviously different from their peers in performance on examinations and abilities as evaluated by the chief of their program, can profit from an opportunity to complete the certification process prior to the normal time requirements. The Study also seems to suggest that the estimation of ability and prognosis for success, when made jointly by the chief and the resident, is highly accurate.

Orthopaedic In Training and Certification Examination Multiple Choice Scores

The designs for both the OITE and the OCE came from Phase I of the Orthopaedic Training Study. Both exams employ a series of multiple choice questions in ten areas of orthopaedics, patient management problems, and ratings by the chief of the resident's training program. In addition, the OCE contains several more ratings by associates of the

candidate and a number of individually administered oral examinations. This study examined the correlation between similar scores on each examination. Only the multiple choice scores were examined since PMP scoring was different on the two exams and could not be directly compared.

Although the basic design of the two exams was similar, differences in construction, residents preparation, and administration exist. The OITE is constructed by a committee of the American Academy of Orthopaedic Surgery and the OCE is constructed by a committee of the American Board of Orthopaedic Surgery. The Academy constructs the OITE as a diagnostic instrument meant to indicate residents' relative strengths and weaknesses. It is therefore composed of questions with a wide range of difficulty so that one can clearly distinguish between high ability and low ability residents. The Board constructs the OCE as a certification instrument and it is therefore criterion oriented. Knowledge and abilities thought essential for any competent orthopaedist are included and all candidates are expected to obtain a certain minimum score. For the OITE residents often make no advance preparation and therefore test scores arr reflective of their long term knowledge. On the other hand, many resident candidates for the OCE attend courses designed to prepare them for the examination. The candidates often review past years of the Bone and Joint Journal and read through a text on orthopaedics. The OITE provides precise directions regarding administration of the exam but there is evidence that these directions are not followed as closely as they are for the OCE, since there are many different examination settings for the OITE.

Considering all the differences between these examinations it was significant correlations between similar scores on each exam were found. The OCE scores on the 1971 exam were matched with the fourth year OITE scores for 321 residents. A correlation of .14 is significant at the .01 level.

TABLE III - 8

Correlations between OITE and OCE Scores

Scores	Correlation
Total multiple choice (M/C)	.58**
M/C adult orthopaedics	.41**
M/C children's orthopaedics	.42**
M/C trauma	.35**
M/C general orthopaedics	.32**
M/C anatomy	.34**
M/C physiology-biochemistry	.31**
M/C pathology	.31**
M/C biomechanics	.19**
M/C rehabilitation	.20**
M/C hand surgery	.24**

**p $<$ .01

IV - PREDICTION STUDY

This final section of the report is an attempt to predict resident performance on the multiple choice and PMP sections of the OITE from knowledge of resident background characteristics, his attitudes and perceptions about his residency program, and characteristics of that program. The significance of this analysis lies in the investigation of the interplay between the personal characteristics and previous history of the resident and the subsequent program structures and experiences which he will encounter in residency. Essentially, this section attempts to examine the program environment for which a resident is most suited, where most suited is defined in terms of OITE performance only.

The use of OITE scores as a criterion for judging resident performance has certain limitations. The actual surgical competence of a resident is virtually impossible to test by timed paper and pencil tests and is consequently not considered in this analysis. Secondly, a test is a somewhat artificial situation in which some different skills from those utilized in the practice of orthopaedics are employed. The ability to function under time restrictions, to recall information from memory, and to choose from presented alternatives are advantages in the OITE which do not necessarily play a role in the practice of orthopaedics. Despite these limitations, the fourth year OITE scores were felt to yield the most valid evaluation of orthopaedic education, and were the most objective criteria upon which to assess resident education.

Sample

All residents in the fourth year of residency from the Study sample for whom scores were reported on the multiple choice and PMP parts of the OITE were included in this analysis. There was a total of 419 residents with the following program designations:

1. 373 Residents from University programs (89%)[1]

2. 13 Residents from University-affiliated programs (3%)

3. 33 Residents from Independent programs (8%)

As is apparent from these figures, this analysis will be heavily influenced by residents from university programs and this should be kept in mind in interpreting the subsequent results. In order to compensate for the university program emphasis, separate analyses will also be included which are restricted to residents from independent programs.

Method

Items from the various Orthopaedic Training Study questionnaires were selected as possible sources related to variation in performance on the OITE. The list of items used and the questionnaires from which they were taken is presented in Table 1. (The Supplement contains the questionnaire from which the items were taken). If a resident had not responded to items which were used in this analysis, the average response for that item replaced the missing information.

The statistical technique used in this analysis is multiple regression, which is essentially a correlation between a combination of variables and a criterion. As with the previous analytic studies, a correlation indicates the strength of an association between variables, and in the case of regression, the strength of the association between a combination of variables and a criterion.

---

[1]The definitions of these terms is presented in the section of the Final Report which is concerned with Program Characteristics. The definitions appear as the first three footnotes of that section.

TABLE IV - 1

ITEMS INCLUDED IN THE PREDICTION STUDY

	Item	Item Source
Personal Data	Marital status	Background Survey
	Age	Background Survey
	Father's Education Level	Background Survey
	Mother's Educational Level	Background Survey
	Parental Income	Background Survey
	High School Grade Point Average	Background Survey
	College Grade Point Average	Background Survey
	Medical School Grade Point Average	Background Survey
	Age at which resident decided on medicine	Background Survey
	Age at which resident decided on orthopaedics	Background Survey
	Any other occupation considered	Background Survey
	Perception of residency competition	Background Survey
	Type of career anticipated	Background Survey
Attitudes	Specialty board requirements are too rigid	Attitude Survey
	Sufficient opportunity to develop and use operative skills in the program	Attitude Survey
	Number of private patients is inadequate	Attitude Survey
	Too many ward patients on my service	Attitude Survey
	Residents knew the specific objectives of the program	Attitude Survey
	Too little elective time on my service	Attitude Survey
	Teaching takes time away from other important activities	Attitude Survey
	Demands on residents are impossible to meet	Attitude Survey
	I would select this residency program again	Attitude Survey
Resident Activities	Number of times I debrided an open fracture	Procedures Form
	Confidence in debriding an open fracture	Procedures Form
	Number of times I internally fixed a reduced fractured hip	Procedures Form
	Confidence in internally fixing a reduced fractures hip	Procedures Form
	Number of times I performed a hip arthroplasty	Procedures Form
	Confidence in performing a hip arthroplasty	Procedures Form
	Initial pre-operative decisions	Evaluation of Operative Procedures
	Pre-operative management	Evaluation of Operative Procedures
	Operative procedure	Evaluation of Operative Procedures
	Handling of complications	Evaluation of Operative Procedures
	Post-operative evaluation	Evaluation of Operative Procedures
	Emergency Room Management	Evaluation of Operative Procedures
	Time spent in Emergency Room	Time Log
	Time spent in performing surgery	Time Log
	Time spent in Teaching	Time Log
	Time spent in school learning	Time Log
Program Characteristics	Type of program	Program Questionnaire
	Geographical organization of the program	Program Questionnaire
	Location of chief's office	Program Questionnaire
	Number of attending staff members	Program Questionnaire
	Attendings time in clinical work	Program Questionnaire
	Attendings time in teaching	Program Questionnaire
	Orientation of the attending staff	Program Questionnaire
	Number of program residents	Program Questionnaire
	Admissions Criteria	Program Questionnaire
	Program Length	Program Questionnaire
	Program Objectives	Program Questionnaire
	Number of types of out-patient clinics	Program Questionnaire
	Number of types of sub-specialties on staff	Program Questionnaire
	Number of types of associated facilities	Program Questionnaire
	Basic Science curriculum	Program Questionnaire
	Teaching responsibilities	Program Questionnaire
	Research paper requirement	Program Questionnaire
	Papers at meetings	Program Questionnaire
	Resident training supervision	Program Questionnaire
	Feedback to resident	Program Questionnaire
	Patient Care responsibilities	Program Questionnaire
	Surgical supervision	Program Questionnaire
	Number of failures in the program	Program Questionnaire

It should be remembered, however, that association among variables is not indicative of causal relationships. Also, in this analysis, there will be no significance levels presented because all reported variables and their combinations were significant at the .05 level. That is to say, that the probability that the associations observed among these variables was due to chance was less than five percent.

Regression has the advantage over correlational analysis of permitting an assessment of variables in combination as predictors of a criterion. Briefly, the technique determines which variable is most highly related to the criterion, then the variable which is next most highly related, given the influence of the previous variable, etc. In this way, unique combinations of variables can be abstracted which allow more precise estimation or prediction of an individual's performance on the criterion.

Results

TOTAL MULTIPLE CHOICE SCORE

A standard score on the total multiple choice section of the OITE was computed for all fourth-year residents who had taken the examination. The sample had a mean of 50.0 and a standard deviation of 10.0. The mean was 52.1, with a standard deviation of 9.5 for the 419 residents included in this analysis. With this measure as a criterion, seven variables were found to be optimally functional for prediction of performance on the OITE multiple choice section. Table 2 presents these items in descending order of their relative power for prediction, along with the cumulative prediction power of the preceding variables in the analysis. That is, the ability to predict increases as more variables are included in the analysis and the third column of each table presents this cumulative increase.

TABLE IV - 2

INTERACTION OF RESIDENT AND PROGRAM CHARACTERISTICS IN PREDICTING MULTIPLE CHOICE SCORES

Item[2]	Positive Item Response	Cumulative Predictive Power
Admissions Criteria- Technical Aptitude	Less Important	7.26
Type of Program	University	11.69
Too many ward cases	Disagree	15.06
Surgical Supervision	When needed	18.01
College Grade Point Average	High	20.72
Admissions Criteria- Intellectual Approach to problems	More Important	22.99
Not enough elective time	Disagree	24.87

This table shows several trends. First of all, with the exception of college grade point average, all items which are significant in the prediction of total multiple choice score are program variables or attitudinal sets which are developed in response to a program environment. Secondly, residents in programs which seem to emphasize technical aptitude tend to perform less well on multiple choice sections, while residents in programs stressing intellectual endeavors perform better on the OITE. This may be due to the relative importance of orthopaedic surgical competence in the former programs in comparison to the importance of "book" learning, which is the thrust of the OITE. Finally, in programs where residents perceive strong service demands, there tends to be a lower score on the multiple choice part of the OITE. This finding may be attributable to an actual lack of time to devote to book learning or it may be that these attitudinal items are measuring underlying dissatisfaction with the programs or with orthopaedics in general.

[2]All items are included in the Supplement.

Having now investigated the interaction between characteristics of the resident and program influences, the relationship of program characteristics, when the background of the resident was controlled for in the analysis, was examined. That is, abstracting out the influence of any personal characteristics of the resident, such as, college grade point average, the most salient influences of the programs on OITE performance were investigated. Table 3 presents the results of this analysis.

TABLE IV - 3

PROGRAM CHARACTERISTICS RELATED TO MULTIPLE CHOICE SCORE PREDICTION

Item	Positive Item Response	Cumulative Predictive Power
Admissions Criteria- Technical Aptitude	Less Important	7.26
Type of Program	University	11.69
Too many ward cases	Disagree	15.06
Surgical Supervision	When needed	18.01
Admissions Criteria- Intellectual Approach to problems	More Important	20.13
Not enough elective time	Disagree	21.92
Use of Operative Skills	Disagree	23.21

It is clear from this analysis that, despite the unique personal characteristics of the resident, program structures and resident attitudes formed in response to those structures are predictive of OITE performance. This result, may, however, be slightly artifactual, due to the heavy weighting of university program residents in this analysis. That is to say, the policy of surgical supervision as needed and the de-emphasis on technical aptitude as an admissions criterion are characteristics of university programs in general and these characteristics may be expected to give separate results within this sample. Further substantiation for thi argument is the relative importance of university progr as predictive of resident OITE performance, as indicat this table.

In order to dissect further this apparent strong influence of program characteristics on OITE performance and to investigate the possible artifactual nature of these relationships, an analysis was performed separately for residents in university and independent programs.[3] The 373 residents in university programs had an average OITE total multiple choice score of 53, and a standard deviation of 9. Table 4 presents the significant influences on OITE performance for university residents.

TABLE IV - 4

CHARACTERISTICS OF RESIDENTS AND PROGRAMS
RELATED TO OITE MULTIPLE CHOICE SCORES
(University Programs)

Item	Positive Item Response	Cumulative Predictive Power
Admissions Criteria-Technical Aptitude	Less Important	6.62
College Grade Point Average	High	11.07
Too many ward cases	Disagree	14.88
Surgical Supervision	When Needed	18.53
Impossible to meet demands	Disagree	20.40

It is interesting to note that, when the type of program is held constant, the influence of a background characteristic of the resident, his college grade point average, is more strongly predictive of subsequent performance than are program characteristics which are influential when the sample was more heterogeneous. There are at least two possible interpretations of these results. The environments of university programs may be sufficiently homogeneous that any differences between them are unimportant in predicting

[3]University-affiliated program residents were excluded from a separate analysis because there were not a sufficient number of them.

subsequent performance. That is to say, it may be that the only relevant program characteristic is the overall type of program rather than the variations within a specific type of program.

On the other hand, it may be that university programs are able to be more selective in their recruiting practices than are orthopaedic training programs in general due to the greater demand for positions in university programs. This would allow university programs to choose residents who would be more suited for success in their programs. As a consequence, the prior achievement of the residents would become the most relevant predictor of future performance, with the unique configuration of program structures among these programs being less relevant. If admissions requirements are more competitive, it would probably follow that the residents chosen would be more well-suited for the demands of the programs and consequently, prior achievement would be most important in predicting future achievement.

The 33 residents from independent programs had an average OITE multiple choice score of 45 and a standard deviation of 10. The most significant characteristics in predicting their OITE scores are displayed on Table 5.

TABLE IV - 5

CHARACTERISTICS OF RESIDENTS AND PROGRAMS RELATED TO OITE MULTIPLE CHOICE SCORES
(Independent Programs)

Item	Positive Item Response	Cumulative Predictive Power
Papers at annual meetings	Yes	38.73
Perceived residency competition	Less	57.55
Full-time attending staff in clinical work	Greater	64.90
Time spent in performing surgery	Less	69.11
Admissions Criteria-Technical Aptitude	More Important	72.95

Before discussing possible explanations of the results from this table, it is important to note that the increase in variance accounted for in this analysis is partially a function of the smaller number of subjects in independent programs. That is, the statistical manipulation enables better prediction when sample size is small, rather than a necessarily better understanding of the multi-faceted nature of performance within independent programs.

Residents who are in independent programs which are less competitive, more clinical and research-oriented, emphasize technical aptitude, and de-emphasize the performance of surgery receive higher OITE multiple choice scores than residents in other types of independent programs. The background characteristics of the resident do not seem to influence his subsequent performance. Rather, the environment of the program and his perception of that environment appear to be the strongest predictors of OITE performance for residents in independent programs.

There are three additional informative findings from these separate analyses which should be noted. First, residents, on the average, in university programs perform at a statistically higher level on the OITE than do residents in independent programs. Secondly, the only program influence common to the prediction of OITE scores between the two types of programs is the importance placed on technical aptitude in the selection process. However, with respect to this influence, the import of this selection criterion is reversed for the two program types. Finally, the lack of perceived competition in independent programs is positively related to subsequent performance. Conversely, an argument could be made that in university programs, the more competitive environment, in terms of selection, results in a greater emphasis on prior achievement as predictive of residency success, as measured by the OITE.

TOTAL PATIENT MANAGEMENT PROBLEMS SCORES

As with the multiple choice scores, a standard score was computed for all fourth-year residents. The group had a mean of 50.0 with a standard deviation of 10.0, while the 419 residents in the analysis had a mean PMP total

score of 51.0, with a standard deviation of 9.0. Table 6 displays the influences most strongly related to performance on the PMP section of the OITE:

TABLE IV - 6

INTERACTION OF RESIDENT AND PROGRAM CHARACTERISTICS IN PREDICTING PMP SCORES

Item	Positive Item Response	Cumulative Predictive Power
Outpatient Trauma Respon.	Earlier	1.69
Admissions Criteria-Technical Aptitude	Less Important	4.14
Surgical Supervision	When needed	6.29
Affiliated Program	No	7.84
School Learning	More time	9.02

It is clear from this table that personal characteristics of the residents do not influence the prediction of PMP total score. Rather, the extent of independence and responsibility available to a resident are the most significant estimators of problem solving ability as measured by the PMP's. It is also significant that two of the items which were predictive of multiple choice scores were also predictive of PMP scores, technical aptitude and surgical supervision. This may not be particularly surprising as the two tests scores are positively correlated (.32), indicating that certain program structures may be mutually beneficial in influencing both "book learning" and problem solving ability. That is, as there is a positive association between PMP score and multiple choice score, it may be that some of the same program characteristics that are associated with high performance on the PMP are also associated with high performance on the multiple choice section.

As none of the items related to personal characteristics of the residents aided the prediction of PMP performance, it was unnecessary to control for these influences in a subsequent analysis. Instead, the analyses were performed separately for university and independent programs

to determine if the ability to predict PMP score would be improved by examining the two types of programs separately. The results of the analysis for the residents in university programs are presented on Table 7.

TABLE IV - 7

CHARACTERISTICS OF RESIDENTS AND PROGRAMS RELATED TO OITE PMP SCORES
(University Programs)

Item	Positive Item Response	Cumulative Predictive Power
Surgical Supervision	When needed	3.18
Admissions Criteria-Technical Aptitude	Less Important	5.61
Complex Procedures	Earlier	8.01
High School Grade Point Average	Higher	9.23
Teach Allied Health Personnel	No	10.31

Again, it is interesting to note that program influences appear to be more significant in predicting performance than personal characteristics of the residents. This is true, even when the program type is held constant. On the other hand, when the same analysis was performed with total multiple choice score as the criterion, the influence of college grade point average was the second most relevant predictor of performance (see Table 4). In this analyses, high school grade point average was the fourth most relevant predictor of PMP performance. This is interesting both because its predictive power is considerably less than was college grade point average for the corresponding multiple choice analyses and because this is the first time that the importance of high school grades have been observed in any of the analyses. It is also clear that the ability to predict PMP performance is considerably weaker than the ability to predict multiple choice performance because the total cumulative

prediction power with PMP as a criterion is 10.31 as compared to 24.87 with multiple choice score as a criterion.

Table 8 displays the results of the analysis for residents in independent programs. Again, a word of caution is necessary in interpreting these results, due to the small number of residents included in the analysis.

TABLE IV - 8

CHARACTERISTICS OF RESIDENTS AND PROGRAMS RELATED TO OITE PMP SCORES
(Independent Programs)

Item	Positive Item Response	Cumulative Predictive Power
Specific Objectives known	Agree	23.62
Impossible to meet demands	Agree	38.79
Resident training supervision	Close	46.82
Board requirements are too rigid	Disagree	54.42

With the exception of the supervision of resident training, the attitudinal dispositions of the residents in independent programs seem to be most influential in predicting of PMP performance. If program objectives are known and Board requirements are deemed sufficiently flexible, residents tend to perform well on the PMP section of the OITE.

The findings with respect to supervision and work demands are suggestive in that within an independent program environment these findings may be a reflection of the caliber of the program. If residents perceive impossible demands and if the program reports close supervision, then the educational environment for these residents is atypical of independent programs. That is, the typical independent program is less concerned with teaching and educational opportunities as their service demands consume most of the attending staff

time. If, on the other hand, residents are being provided with educational opportunities superimposed on patient care obligations, the educational caliber of the program is enhanced. The PMP performance of these residents may be suggestive of this type of program environment.

Discussion and Summary

The ability to determine the relative influences on performance indicates that the types and specific characteristics of residency programs are clearly significant in educating orthopaedists. It appears that, once an intern has been accepted into a program, the unique program structures determine subsequent performance to a greater extent than the characteristics with which the resident entered the program. This is undoubtedly due, in part, to the preselection of residents which results in a relatively homogeneous group of people. Having followed the same progression from college to medical school, to surgery, and finally, into orthopaedics, it is not particularly surprising that the personal characteristics of the residents are less influential in prediction of criterion performance than are program characteristics. To the extent that these personal characteristics are still operating to influence performance, the question becomes one of fitting the prospective resident and program together for the optimal benefit of each.

With respect to significant program characteristics, the suggestive trend indicates that subsequent performance is more associated with selection criteria and the educational opportunities than it is with the size or professional orientation of the attending staff, or with the structuring of the curriculum. Rather, it appears that, with respect to OITE performance, residents in programs with selection criteria which emphasize intellectual endeavors, de-emphasize technical aptitude, and a program which allows residents educational and surgical opportunities perform better on the OITE tests. Thus, it appears that the attitudinal set of the attending staff with respect to educational experiences is a better predictor of subsequent achievement than the size and specific structures of the program.

It also seems evident from this analysis that the influences on "book learning" performance are more discernible than those on problem solving ability. This is probably not surprising, given the relatively structured nature of the multiple choice section of the OITE as contrasted with the relatively less structured interpretive PMP section of the examination. Clearly, the more defined and concrete the performance criterion, the more precise the prediction of the performance. However, it does not necessarily follow from this that one ability is more desirable than the other, only that there are differential influences on the two abilities. Thus, in evaluating the success of an orthopaedic program, both of these components of orthopaedic competence should be considered, as well as attempts to assess the surgical competence of the residents.